DEPARTMENT OF THE NAVY (DoN)
15.1 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

INTRODUCTION

Responsibility for the implementation, administration, and management of the Department of the Navy (DoN) SBIR Program is with the Office of Naval Research (ONR). The Acting Director of the DoN SBIR Program is Mr. Robert Smith, robert.l.smith6@navy.mil. For program and administrative questions, please contact the Program Managers listed in Table 1; **do not** contact them for technical questions. For technical questions about the topic, contact the Topic Authors listed for each topic during the period **12 December 2014 through 14 January 2015.** Beginning **15 January 2015**, the SBIR/STTR Interactive Technical Information System (SITIS) (www.dodsbir.net/Sitis) listed in Section 4.15.d of the DoD SBIR Program Solicitation must be used for any technical inquiry. For inquiries or problems with electronic submission, contact the DoD SBIR/STTR Help Desk at 1-866-724-7457 (8:00 a.m. to 5:00 p.m. ET).

TABLE 1: NAVY SYSTEMS COMMANDS (SYSCOM) SBIR PROGRAM MANAGERS

Topic Numbers	Point of Contact	Activity	Email
N151-001 thru N151-004	Ms. Elizabeth Madden	MARCOR	elizabeth.madden@usmc.mil
N151-005 thru N151-026	Ms. Donna Moore	NAVAIR	navair.sbir@navy.mil
N151-027 thru N151-060	Mr. Dean Putnam	NAVSEA	dean.r.putnam@navy.mil
N151-061 thru N151-079	Ms. Lore-Anne Ponirakis	ONR	loreanne.ponirakis@navy.mil
N151- 080	Mr. John Thom	SPAWAR	john.thom@navy.mil

The Navy's SBIR Program is a mission oriented program that integrates the needs and requirements of the Navy's Fleet through R&D topics that have dual-use potential, but primarily address the needs of the Navy. Companies are encouraged to address the manufacturing needs of the Defense Sector in their proposals. Information on the Navy SBIR Program can be found on the Navy SBIR/STTR website at www.navysbir.com. Additional information pertaining to the DoN's mission can be obtained from the DoN website at www.navy.mil.

PHASE I GUIDELINES

Follow the instructions in the DoD SBIR Program Solicitation at www.dodsbir.net/solicitation for program requirements and proposal submission guidelines. Please keep in mind that Phase I should address the feasibility of a solution to the topic. It is highly recommended that proposers follow the Navy proposal template located at www.navysbir.com/submission.htm as a guide for structuring proposals. Inclusion of cost estimates for travel to the sponsoring SYSCOM's facility for one day of meetings is recommended for all proposals.

Technical Volumes that exceed the **20** page limit will be reviewed only to the last word on the **20th** page. Information beyond the **20th** page will not be reviewed or considered in evaluating the proposal. To the extent that mandatory technical content is not contained in the first 20 pages of the proposal, evaluators may deem the proposal as non-responsive and score it accordingly.

The Navy requires proposers to include, within the **20-page limit**, an option that furthers the effort and will bridge the funding gap between Phase I and the Phase II start. Phase I options are typically exercised upon the decision to fund the Phase II. **The Phase I base amount and Period of Performance shall not exceed**

$80,000 and six months; the Phase I option amount and Period of Performance shall not exceed $70,000 and six months.

PHASE I PROPOSAL SUBMISSION CHECKLIST:

The following criteria <u>must be met</u> or the proposal will be REJECTED.

____1. Include a header with company name, DoD proposal number, and DoD topic number on each page of your Technical Volume.

____2. Include tasks (separately) to be completed during the option period in the 20-page Technical Volume and include the costs as a separate section in the Cost Volume. Costs for the base and option should be clearly separate, and identified on the Proposal Cover Sheet, in the Cost Volume, and in the work plan section of the proposal.

____3. BREAK OUT SUBCONTRACTOR, MATERIAL AND TRAVEL COSTS IN DETAIL. In the Cost Volume, it is important to provide sufficient detail for the subcontract, material and travel costs. Subcontractor costs should be detailed at the same level as the prime to include at a minimum personnel names, rate per hour, number of hours, material costs (if any), and travel costs (if any). Material costs should include at a minimum listing of items and cost per item. Travel costs should include at a minimum the purpose of the trip, number of trips, location, length of trip, and number of personnel. Use the "Explanatory Material Field" in the DoD Cost Volume worksheet for this information.

____4. If Discretionary Technical Assistance (DTA) is proposed, add information required to support DTA in the "Explanatory Material Field" in the DoD Cost Volume worksheet.

____**5. The Phase I base amount and Period of Performance shall not exceed $80,000 and six months and the option amount and Period of Performance shall not exceed $70,000 and six months. The costs for the base and option periods are clearly separate, and identified on the Proposal Cover Sheet, in the Cost Volume, and in the Technical Volume. If proposing direct DTA, a total of up to $5,000 combined may be added to the Base or Option periods.**

____6. Upload the Technical Volume and the DoD Proposal Cover Sheet, the DoD Company Commercialization Report, and Cost Volume electronically through the DoD submission site (https://www.dodsbir.net/submission/SignIn.asp) by 6:00 am ET, 18 February 2015.

____7. After uploading the file on the DoD SBIR/STTR submission site, review it to ensure that it appears correctly. Contact the DoD SBIR/STTR Help Desk immediately with any problems.

PHASE II GUIDELINES

All Phase I awardees will be allowed to submit an **Initial** Phase II proposal for evaluation and selection. The Phase I Final Report, Initial Phase II Proposal, and Transition Outbrief (as applicable), will be used to evaluate the offeror's potential to progress to a workable prototype in Phase II and transition technology in Phase III. Details on the due date, content, and submission requirements of the Initial Phase II Proposal will be provided by the awarding SYSCOM either in the Phase I award or by subsequent notification. **NOTE: All SBIR/STTR Phase II awards made on topics from solicitations prior to FY13 will be conducted in accordance with the procedures specified in those solicitations (for all DoN topics, this means by invitation only).**

Section 4(b)(1)(ii) of the SBIR Policy Directive permits the Department of Defense and by extension the DoN, during fiscal years 2012 through 2017, to issue a Phase II award to a small business concern that did not receive a Phase I award for that R/R&D. **NOTE:** The DoN will NOT be exercising this authority for SBIR Phase II awards. **Therefore, in order for any small business firm to receive a Phase II award, the firm must be a recipient of a Phase I award under that topic and submit an Initial Phase II proposal.**

The Navy typically awards a cost plus fixed fee contract for Phase II. The Phase II contracts can be structured in a way that allows for increased funding levels based on the project's transition potential. To accelerate the transition of SBIR-funded technologies to Phase III, especially those that lead to Programs of Record and fielded systems, the Commercialization Readiness Program was authorized and created as part of section 252 of the National Defense Authorization Act of Fiscal Year 2006. The statute set-aside is 1% of the available SBIR funding to be used for administrative support to accelerate transition of SBIR-developed technologies and provide non-financial resources for the firms (e.g. the Navy's Transition Assistance Program).

DISCRETIONARY TECHNICAL ASSISTANCE

The SBIR Policy Directive section 9(b), allows the DoN to provide discretionary technical assistance (DTA) to its awardees to assist in minimizing the technical risks associated with SBIR projects and commercializing products and processes. Firms may request, in their Phase I and Phase II proposals, to contract these services themselves in an amount not to exceed $5,000 per year. This amount is in addition to the award amount for the Phase I or Phase II project.

Approval of direct funding for DTA will be evaluated for approval by the DoN SBIR office if the firm's proposal (1) clearly identifies the need for assistance (purpose and objective of required assistance), (2) provides details on the provider of the assistance (name and point of contact for performer); and unique skills/specific experience to carry out the assistance proposed, and (3) the cost of the required assistance (costs and hours proposed or other details on arrangement). This information must be included in the firm's cost proposal specifically identified as "Discretionary Technical Assistance" and cannot be subject to any profit or fee by the requesting SBIR firm. In addition, the provider of the DTA may not be the requesting firm, an affiliate of the requesting firm, an investor of the requesting firm, or a subcontractor or consultant of the requesting firm otherwise required as part of the paid portion of the research effort (e.g. research partner). Failure to include the required information in the proposal will result in the request for DTA being disapproved. Exceeding proposal limits identified for Phase I ($150,000 for Base, Option, and DTA) without including the required identification of DTA will result in the proposal's REJECTION without evaluation.

Phase I awardees that propose more than $150,000 in total funding (Base, Option and DTA) cannot receive a purchase order. Purchase orders are a type of Simplified Acquisition Procedure (SAP) intended to reduce administrative costs, promote efficiency and economy in contracting, and avoid unnecessary burdens for agencies and contractors. The need to issue a Firm Fixed Price (FFP) contract may result in contract delays if the SYSCOM normally issues purchase orders for Phase I awards.

If a firm requests and is awarded DTA in a Phase II proposal, it will be eliminated from participating in the Navy Transition Assistance Program (TAP), the Navy Opportunity Forum, and any other assistance the Navy provides directly to awardees.

All Phase II awardees not receiving funds for DTA in their award must attend a one-day Navy TAP meeting during the second year of the Phase II. This meeting is typically held in the summer in the Washington, D.C. area. Information can be obtained at: www.dawnbreaker.com/navytap. Awardees will be contacted separately regarding this program. It is recommended that Phase II cost estimates include travel to Washington, D.C. for this event.

PHASE III GUIDELINES

A Phase III SBIR award is any work that derives from, extends, or completes effort(s) performed under prior SBIR funding agreements, but is funded by sources other than the SBIR Program. Thus, any contract or grant where the technology is the same as, derived from, or evolved from a Phase I or a Phase II SBIR/STTR contract and awarded to the company that was awarded the Phase I/II SBIR is a Phase III SBIR contract. This covers any contract/grant issued as a follow-on Phase III SBIR award or any contract/grant award issued as a result of a competitive process where the awardee was an SBIR firm that developed the technology as a result of a Phase I or Phase II SBIR. The Navy will give SBIR Phase III status to any award that falls within the above-mentioned description, which includes assigning SBIR Data Rights to any noncommercial technical data and/or noncommercial computer software delivered in Phase III that was developed under SBIR Phase I/II effort(s). Government prime contractors and/or their subcontractors follow the same guidelines as above and ensure that companies operating on behalf of the Navy protect the rights of the SBIR company.

EVALUATION AND SELECTION

The Navy will evaluate and select Phase I and Phase II proposals using the evaluation criteria in Sections 6.0 and 8.0 of the DoD SBIR Program Solicitation respectively, with technical merit being most important, followed by qualifications of key personnel and commercialization potential of equal importance. Due to limited funding, the Navy reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded. **NOTE: The Navy does NOT participate in the FAST Track program.**

Protests of Phase I and II selections and awards shall be directed to the cognizant Contracting Officer for the Navy Topic Number. Contact information for Contracting Officers may be obtained from the Navy SYSCOM SBIR Program Managers listed in Table 1.

One week after Phase I solicitation closing, e-mail notifications that proposals have been received and processed for evaluation will be sent. Consequently, e-mail addresses on the proposal coversheets must be correct.

The Navy typically awards a Firm Fixed Price (FFP) contract or a small purchase agreement for Phase I.

In accordance with section 4.10 of the DoD Instructions, requests for a debrief must be made within 30 days of non-award notification.

CONTRACT DELIVERABLES

Contract deliverables are typically progress reports and final reports. Deliverables required by the contract, shall be uploaded to https://www.navysbirprogram.com/navydeliverables/.

AWARD AND FUNDING LIMITATIONS

In accordance with SBIR Policy Directive section 4(b)(5), there is a limit of one sequential Phase II award per firm per topic. Additionally in accordance with SBIR Policy Directive section 7(i)(1), each award may not exceed the award guidelines (currently $150,000 for Phase I and $1 million for Phase II, excluding DTA) by more than 50% (SBIR/STTR program funds only) without a specific waiver granted by the SBA.

TOPIC AWARD BY OTHER THAN THE SPONSORING AGENCY

Due to specific limitations on the amount of funding and number of awards that may be awarded to a particular firm per topic using SBIR/STTR program funds (see above), Head of Agency Determinations are now required (for all awards related to topics issued in or after the SBIR 13.1/STTR 13A solicitation) before a different agency may make an award using another agency's topic. This limitation does not apply to Phase III funding. Please contact the original sponsoring agency before submitting a Phase II proposal to an agency other than the one that sponsored the original topic. (For DoN awardees, this includes other Navy SYSCOMs.)

TRANSFER BETWEEN SBIR AND STTR PROGRAMS

Section 4(b)(1)(i) of the SBIR Policy Directive provides that, at the agency's discretion, projects awarded a Phase I under a solicitation for SBIR may transition in Phase II to STTR and vice versa. A firm wishing to transfer from one program to another must contact its designated technical monitor to discuss the reasons for the request and the agency's ability to support the request. The transition may be proposed prior to award or during the performance of the Phase II effort. Agency disapproval of a request to change programs will not be grounds for granting relief from any contractual performance requirement(s). All approved transitions between programs must be noted in the Phase II award or an award modification signed by the contracting officer that indicates the removal or addition of the research institution and the revised percentage of work requirements.

ADDITIONAL NOTES

1. Due to the short timeframe associated with Phase I of the SBIR process, the Navy does not recommend the submission of Phase I proposals that require the use of Human Subjects, Animal Testing, or Recombinant DNA. For example, the ability to obtain Institutional Review Board (IRB) approval for proposals that involve human subjects can take 6-12 months, and that lengthy process can be at odds with the Phase I goal for time to award. Before Navy makes any award that involves an IRB or similar approval requirement, the proposer must demonstrate compliance with relevant regulatory approval requirements that pertain to proposals involving human, animal, or recombinant DNA protocols. It will not impact the Navy's evaluation, but requiring IRB approval may delay the start time of the Phase I award and if approvals are not obtained within two months of notification of selection, the decision to award may be terminated. If the use of human, animal, and recombinant DNA use is included under a Phase I or Phase II proposal, please carefully review the requirements at: http://www.onr.navy.mil/About-ONR/compliance-protections/Research-Protections/Human-Subject-Research.aspx. This webpage provides guidance and lists approvals that may be required before contract/work can begin.

2. Due to the typical lengthy time for approval to obtain Government Furnished Equipment (GFE), it is recommended that GFE is not proposed as part of the Phase I proposal. If GFE is proposed and is determined during the proposal evaluation process to be unavailable, proposed GFE may be considered a weakness in the proposal.

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NAVY SBIR 15.1 Topic Descriptions

N151-001 TITLE: Improved Softwall Shelter Heating System

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: PM Combat Support Systems (CSS), PdM Combat Support Equipment (CSE)

OBJECTIVE: To develop an improved, self-starting, multi-fuel burning heating system capable of circulating heated air inside all softwall shelters fielded by the Marine Corps. This technology should enable a reduction in both the dependency on liquid fuels in the field and the logistics tail associated with the transportation and storage of these fuels.

DESCRIPTION: Marine Corps operational requirements address the reduction of fossil fuel consumption, the use of alternative fuels and improvements to energy efficiency (Ref. 1, 2). Examples addressing this requirement include: reducing liquid fossil fuel consumption, reducing cube/size and weight of operational equipment, and reducing the logistics burden of softwall shelters. The Marine Corps currently employs forced air and radiant heaters (Ref. 3) for use in softwall shelters used by the Marines (Ref. 4). These heaters are dependent on liquid fossil fuel transported in the field by tanker convoys. These convoys are susceptible to enemy attacks and improvised explosive devices (IEDs) which place Marines at risk. The present softwall shelter heaters used by the Marines are currently only available from one commercial source (Ref. 3). These heaters are designed to burn a range of liquid fuels (DF1, DF2, DFA, JP5, and JP8) which allows for flexibility in the field, but does not allow the use of organic plant based fuel sources, solid fossil fuels, micro-grids/national grids, host nation natural gas or other alternative fuels such as those produced by a chemical conversion process similar in nature to those used in Meals Ready to Eat (MRE)s, hand warmers and boot warmers. Developing a heating system which allows for highly-flexible, multi-fuel usage in the field could allow the use of alternate sources such as, but not limited to, wood, wood pellets, corn husks and other readily available plant based organics, with heat resulting from a bi-product(s) of catalytic chemical processes and other types of sources found in the area where the bivouac is conducted. This will help reduce the need to transport liquid fuel via tanker vehicles and reduce the number of Marines and vehicles on the road. This will also contribute to reducing the number of possible targets of enemy attacks and the logistics burden associated with environmental systems used in theater.

The Marine Corps seeks innovative approaches in this new softwall shelter heating system capable of using both existing fuel sources as well as plant based organics and alternate fuel sources (Ref. 5, 6) while decreasing the packed cube/size and weight of heater systems by 50%. Proposers should be mindful of the desire for heating concepts that exhibit properties that also promote at least 50% reduction in fossil fuel consumption associated with electrical power and packed physical volume/weight. Critical to the operational requirements of the Marine Corps is the ability to improve energy efficiency and reduce its logistical footprint to extend our expeditionary capabilities. Proposed concepts will need to address the ability to circulate heated air within shelters having a square foot area range between 150 to 650 square feet as well as a multi-fuel type burning capability which could allow for the additional use of other alternative fuels as discussed in the preceding paragraph. Proposed concepts should be able to provide heated air at 50 degrees Fahrenheit (°F) from an intake of -25 °F ambient air temperature and operate without the use of an external power source. The setup into an operational mode for this system should be able to be accomplished by no more than two personnel in less than 20 minutes and shall have thermostatic controls to enable automatic adjustment of the heater output range from 10,000 to 45,000 British Thermal Units (BTUs). Proposed concepts should be able to accept fuel from any standard 5 gallon (20 liter) fuel can and have an automatic shut-off capability to stop the flow of fuel to allow change out of the fuel sources and be able to operate for up to 10 hours on 5 gallons (20 liters or equivalent) of fuel. The total weight of the softwall shelter heating system without fuel should not be more than 120 pounds (lbs) Threshold (T) and 60 lbs. Objective (O) inclusive of any identified accessories or additional components deemed necessary for normal operation. The system should be storable and operable in temperatures down to -40 °F to allow use in an arctic environment and have heat input and exhaust connections compatible with current shelters used within the Marine Corps (Ref. 4). Acceptable exhaust levels should be 4 or below on the Bacharach Smoke Scale. The Bacharach Smoke Scale determines efficient combustion of fuel and is the standard method for evaluating smoke density in the flue gases from distillate fuels. Too much or dense smoke shows excessive fuel usage and improper settings for the system.

Proposed concepts shall be able to function in all climates and environments that may be encountered by the United States Marine Corps' (USMC) forces. To ensure this, the proposed solution will have to pass applicable tests outlined in MIL-STD 810F/G (www.everyspec.com). There shall be no significant degradation in the material system's performance when ambient temperatures are between 125°F and -40°F, to the extent outlined in MIL-STD 810F/G. The new technology shall be capable of being employed in all Marine Corps tactical softwall shelters and shall have the ability to be transported in all tactical ground and air vehicles.

PHASE I: The small business will develop concepts for a softwall shelter heater system that meet the requirements as stated in the description section. The company will demonstrate the feasibility of the selected concept(s) in meeting Marine Corps needs and will establish that the concept(s) can be developed into a useful system for the Marine Corps. Feasibility will be established by user testing and analytical modeling, as appropriate. The small business will provide a Phase II development plan with performance goals and key technical milestones that will address technical risk reduction.

PHASE II: Based on the results of Phase I and the Phase II Proposal, the small business will develop a softwall shelter heater system prototype for evaluation. The prototype will be evaluated to determine its capability in meeting the Marine Corps requirements for the softwall shelter heater system described above. System performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters including numerous deployment cycles. Evaluation results will be used to refine the prototype into producible design that will meet Marine Corps requirements. Working with the Marine Corps, the company will prepare a Phase III development plan to detail the strategy for transitioning the technology for Marine Corps use.

PHASE III: If Phase II is successful, the company will be expected to support the Marine Corps in transitioning the heating system for Marine Corps use. The company will further develop and produce softwall shelter heating systems for evaluation to determine its effectiveness in an operationally relevant environment. The company will support the Marine Corps for test and validation to certify and qualify the system for Marine Corps use. The company will prepare manufacturing plans and develop manufacturing capabilities to produce the product for military and commercial markets.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The potential for commercial application and dual use is high. The softwall shelter heater system can be used in commercial and civilian shelters where liquid fuels are not available or in short supply. Additionally, multi-fuel heaters can be used in soft walled shelters employed by emergency management, disaster aid and humanitarian aid agencies as well as by municipal public safety organizations.

REFERENCES:
1. Expeditionary Force 21. Forward and Ready: Now and In the Future. 4 March 2014.
http://www.mccdc.marines.mil/Portals/172/Docs/MCCDC/EF21/EF21_USMC_Capstone_Concept.pdf

2. Marine Corps Expeditionary Energy Office. Marine Corps Expeditionary Energy Strategy and Implementation Plan. March 2011.
http://www.hqmc.marines.mil/Portals/160/Docs/USMC%20Expeditionary%20Energy%20Strategy%20%20Implementation%20Planning%20Guidance.pdf

3. HDT Engineered Technologies website. 08 July 2014. http://www.hdtglobal.com/index.php?s=heater

4. RDECOM. "Department of Defense Standard Family of Tactical Shelters (rigid/soft/hybrid)." Joint Committee on Tactical Shelters (JOCOTAS). 17 May 2012. http://nsrdec.natick.army.mil/media/print/JOCOTAS.pdf

5. Department of Energy: Wood and Pellet Heating. 25 November 2013.
http://energy.gov/energysaver/articles/wood-and-pellet-heating

6. Wood Pellet Stoves, Current July 2014.
http://www.woodpelletstoves.net/

KEYWORDS: Multi-fuel; alternate fuel; tents; softwall shelters; heaters; energy efficiency

TPOC: David Keeler
Phone: (703)432-3238
Email: david.keeler@usmc.mil

N151-002 TITLE: Light-weight Vehicle Exhaust System for Amphibious Vehicles

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: Program Manager Advanced Amphibious Assault (PM AAA)

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an improved, light-weight, lower-cost, low-thermal conductivity vehicle exhaust system for use in next generation amphibious vehicles.

DESCRIPTION: The United States Marine Corps (USMC) is in the process of developing and procuring armored tracked and wheeled troop carriers designed to operate over harsh off-road terrain and in oceans and rivers (Ref. 1). Currently, amphibious vehicle capabilities are limited due to competing requirements: 1) water mobility, 2) combat effectiveness, 3) carrying capacity, and 4) survivability. Hence, lightweight durable and affordable components and sub-systems are necessary to maximize the overall system capability. The physical environment in which amphibious vehicles operate (seawater) is corrosive for many materials and the problem is exacerbated by high temperatures caused by the vehicle exhaust system. Current state-of-the-art for US military exhaust systems, as implemented on the Amphibious Assault Vehicle, consists of a pipe and muffler. The exhaust system technology implemented on the Expeditionary Fighting Vehicle (EFV) met performance requirements but imposed a severe weight burden on the vehicle and experienced deterioration due to seawater sloshing into the aft portion of the exhaust. The exhaust suffered from accelerated pitting and caused a short product life and high life-cycle cost. The engine used in the EFV was a 12 cylinder diesel and the exhaust system was comprised of aluminum and composite (Ref. 2). The next generation amphibious vehicles have similar performance requirements to the EFV and are projected to utilize a similarly rated engine. As such, this topic is focused on the development of an improved exhaust system that can withstand repeated heating/cooling cycles while minimizing the transfer of heat from engine exhaust to the external surface of the vehicle for personnel safety. Any technology innovations incorporated into next generation amphibious vehicles will need to be lighter and less expensive to acquire while still meeting performance specifications and being robust enough to withstand the demanding operating environments.

The USMC has interest in innovative approaches in the application of advanced material systems to enable the development of a robust, light-weight (less than 500 pounds (lbs)), affordable (less than $100K to acquire) engine exhaust system while simultaneously reducing the thermal conductivity of the vehicle's exhaust to the environment. The exhaust system must be capable of efficient operation across a range of mass flow rates from 0.5 kilogram per second (kg/sec) to 3.5 kg/sec and an overall system backpressure of less than 50 millibar (mbar). The exhaust system must withstand internal pressures of up to 6 pounds per square inch (psi). Proposed concepts should address the ability to function in extreme operating environments which include, but are not limited to, -25 degrees Fahrenheit (°F) to +120°F, hot dessert blowing sand, full salt water immersion and immersion in petroleum-based liquids (Ref. 6). Concepts must be able to withstand indefinite operation with up to 750 degrees Celsius (°C) engine exhaust and not suffer performance degradation including corrosion when exposed repeatedly to quenching with ambient temperature sea water.

The ability to perform in the specified environment without experiencing system degradation as a result (e.g. corrosion or excess wear) is one of the key technical challenges for any proposed material system solution. The proposed concept should minimize thermal transfer from the hot exhaust gasses to the external surfaces. Optimally, the temperature of the exposed surfaces of the exhaust system should match the temperature of the surrounding vehicle surface. The proposed concept must be robust and survivable within the varied operating environment and able to withstand vehicle vibration and ballistic shock requirements (Ref. 3-7). For the purpose of technology development and demonstration, proposers should use the EFV geometries and operating profiles in the development of their concepts (Ref. 2).

The Phase I effort will not require access to classified information. If need be, data of the same level of complexity as secured data will be provided to support Phase I work. The Phase II effort will likely require secure access, and the small business will need to be prepared for personnel and facility certification for secure access.

PHASE I: The company will explore the application of advanced material system concepts for a light-weight, lower-cost, low thermal conductivity vehicle exhaust system alternative for next generation amphibious vehicles. The company will also need to take into account the operating environment in which the exhaust system will be exposed. The company will demonstrate the feasibility of the concept(s) and will establish that the selected concept can be developed into a useful product for the Marine Corps. Feasibility will be established by material testing and analytical modeling as appropriate. The company will provide a Phase II development plan with performance goals and key technical milestones that will address technical risk reduction.

PHASE II: Based upon the results of Phase I and the Phase II Proposal development plan, the company will develop a vehicle exhaust system alternative for next generation amphibious vehicles prototype for evaluation. The prototype will be evaluated to determine its capability in meeting the performance goals specified above and the Marine Corps' requirements for an improved vehicle exhaust system. At a minimum, system performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters under real and/or simulated conditions. Evaluation results will be used to refine the prototype into an initial design that will meet Marine Corps requirements. Working with the Marine Corps, the company will prepare a Phase III development plan to detail the strategy for transitioning the technology for Marine Corps use.

PHASE III: If Phase II is successful, the company will be expected to support the Marine Corps in transitioning the vehicle exhaust system alternative for next generation amphibious vehicles for Marine Corps use. Working with the Marine Corps, the company will integrate their prototype vehicle exhaust system onto an existing vehicle for evaluation to determine its effectiveness in an operationally relevant environment. This technology is directly applicable to large military vehicles such as the Marine Corps' Amphibious Combat Vehicle (ACV) and the Army's Armored Multi-Purpose Vehicle (AMPV). The company will support the Marine Corps for test and validation to certify and qualify the system for Marine Corps use. The company will develop manufacturing plans and capabilities to produce the system for both military and commercial markets.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Successful development and characterization of a lightweight exhaust system has direct application to a wide variety of uses in various military and commercial applications such as commercial trucks, and marine and construction equipment. Reductions in weight and heat from diesel and gas-turbine engines are of substantial value. This technology could also be adapted for use in shrouds around generators, turbine aircraft engines or better thermal shielding for use in automobiles.

REFERENCES:
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8. “Diesel Exhaust Aftertreatment 2000-2007.” 1 April 2008. Retrieved from: http://books.sae.org/pt-126/

KEYWORDS: amphibious vehicle; engine emissions; engine exhaust; thermal transfer; exhaust modulation

TPOC:	Jesse Sumner
Phone:	(703)784-2767
Email:	Jesse.Sumner@usmc.mil
2nd TPOC:	Craig Harvey
Phone:	(703)784-2157
Email:	craig.t.harvey@usmc.mil

N151-003 TITLE: Low Complexity Suspension System for Amphibious Vehicles

TECHNOLOGY AREAS: Ground/Sea Vehicles

ACQUISITION PROGRAM: Program Manager Advanced Amphibious Assault (PM AAA)

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a minimally complex suspension system for up to 40 ton amphibious vehicles capable of moving the wheels or tracks into a position to minimize drag while moving through water for the purpose of improving speed and overall suspension system reliability.

DESCRIPTION: The United States Marine Corps is in the process of developing and procuring armored tracked and wheeled troop carriers designed to operate over harsh off-road terrain and in oceans and rivers (Ref. 1). Currently, amphibious vehicle capabilities are limited due to competing requirements: 1) water mobility, 2) combat effectiveness, 3) carrying capacity, and 4) survivability. For these reasons, light-weight, durable and affordable components and sub-systems which have the potential to maximize the overall system capability are viewed as being highly desirable as technology development initiatives. The suspension system for a high-speed amphibious vehicle needs to accommodate both land and sea travel. This dual mode of operation presents complex engineering challenges. The suspension system technology implemented on the Expeditionary Fighting Vehicle (EFV) reflects the current state-of-the-art for tracked amphibious vehicles. This system used high pressure Hydropneumatic Suspension Units (HSU) that pivot aft to lift the track up to the level of the vehicle’s flat bottom. As can be seen in Reference 1, the EFV was basically a flat bottom brick shape with an extendable bow. In water mode, it retracted the vehicle’s track to minimize water drag and, in land mode, the HSU rotated down to provide 16 inch ground clearance while moving at up to 45 mph across country. While it met performance requirements, it was viewed as: very complex (20+ major components hundreds of feet of piping); requiring a very high (35,000 pounds per square inch (PSI) max) hydraulic pressure system; expensive to acquire; having a projected Mean Time Between Failure (MTBF) of 229 hours which was partially attributed to the complexity of the system.

The Marine Corps is interested in innovative approaches in the development of a suspension system for a 40 ton amphibious vehicle capable of traversing the land portion of the Marine Corps Mission Profile while being retractable to zero ground clearance while the vehicle is operating in the water. Proposed concepts (as a system) should weigh less than 5,000 pounds (lbs.), cost less than $800,000 to acquire and have an improved projected MTBF. Weight, cost, and complexity should not include track, road wheels, or support rollers for tracked systems nor wheels for wheeled systems. For the purpose of technology development and demonstration, proposers should use the EFV geometries and operating profiles in the development of their concepts (Ref 2, 3). Proposed concepts should:

- Address the ability to function in extreme operating environments which include but are not limited to -25 degrees Fahrenheit (°F) to +120°F, hot dessert blowing sand, full salt water immersion and immersion in petroleum based liquids.
- Allow for terrain traverse with combined 3 g-force (G) vertical and 0.7 G horizontal load on suspension station, racking load at diagonal corners for 1 G vertical load, North Atlantic Treaty Organization (NATO) tree impact (5" tree at 32 kilometers per hour (kph)-8365 pound equivalent static load), and fatigue loads for 30 year vehicle life.
- Be capable of withstanding, without performance degradation, all loads imparted in grounding from a speed of 9 knots.
- Not allow ground pressure to exceed 70.67 kiloPascals (kPa) (10.25 psi) and shall have a ground clearance of no less than of 15 inches.
- Support steering in the forward and reverse directions on 40 percent side slopes and ascending, descending, starting, and stopping on a dry hard surfaced longitudinal slope up to and including 60 percent grade in both forward and reverse direction.
- Allow the vehicle to cross a gap no less than 2.44 meters (8 feet) across.
- Robust and survivable within the varied operating environment (Ref. 4 and 5) and able to withstand vehicle vibration and ballistic shock requirements (Ref. 4).

PHASE I: The company will explore the design and development of advanced suspension system concepts for a light-weight, lower-cost, low-complexity, vehicle suspension system alternative for next generation amphibious vehicles. The company needs to consider the operating environment in which the suspension system will be exposed. The company will demonstrate the feasibility of the concept(s) in meeting Marine Corps' needs and will establish that the concept can be developed into a useful product for the Marine Corps. Feasibility will be established by material testing and analytical modeling as appropriate. The company will provide a Phase II development plan with performance goals and key technical milestones that will address technical risk reduction.

PHASE II: Based upon the results of Phase I and the Phase II Proposal, the company will develop a scaled prototype of the suspension system for evaluation. The prototype will be evaluated to determine its capability in meeting the performance goals established for the Marine Corps' amphibious vehicles improved vehicle suspension system as identified above. System performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters. Evaluation results will be used to refine the prototype into a design that will meet Marine Corps requirements. Working with the Marine Corps, the company will prepare a Phase III development plan to detail the strategy for transitioning the technology for Marine Corps use.

PHASE III: If Phase II is successful, the company will be expected to support the Marine Corps in transitioning the suspension system for Marine Corps use. Working with the Marine Corps, the company will integrate their prototype vehicle suspension system into a vehicle for evaluation to determine its effectiveness in an operationally relevant environment. This technology is directly applicable to large military vehicles such as the Marine Corps Amphibious Combat Vehicle (ACV) and the Army's Armored Multi-Purpose Vehicle (AMPV). The company will support the Marine Corps for test and validation to certify and qualify the system for Marine Corps use. The company will develop manufacturing plans and capabilities to produce the system for both military and commercial markets.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Successful development and characterization of a suspension system has direct application to various military and commercial applications such as amphibious rescue vehicles. Reductions of weight and complexity in the suspension can be of substantial value.

REFERENCES:
1. "Expeditionary Fighting Vehicle." Last modified 14 August 2014. Retrieved from: http://en.wikipedia.org/wiki/Expeditionary_Fighting_Vehicle

2. “Expeditionary Fighting Vehicle (EFV).” Last modified 26 August 2012. Retrieved from: http://www.globalsecurity.org/military/systems/ground/aaav-specs.htm

3. Walker, M., “United States Marine Corps Operational Maneuver From The Sea.” Retrieved from: http://www.acq.osd.mil/log/mpp/cbm+/Briefings/Monty_EFV_AG_working_group_overview_Mar08_resize.pdf

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5. MIL-STD-889B Dissimilar Metals. Retrieved from: http://www.everyspec.com/MIL-STD/MIL-STD-0800-0899/MIL_STD_889B_955/

KEYWORDS: Amphibious vehicle; suspension system; retractable suspension; tracked vehicle; wheeled vehicle; hydrodynamic efficiency

TPOC:	Jesse Sumner
Phone:	(703)784-2767
Email:	Jesse.Sumner@usmc.mil
2nd TPOC:	Craig Harvey
Phone:	(703)784-2157
Email:	craig.t.harvey@usmc.mil

N151-004 TITLE: Compact Auxiliary Power System for Amphibious Combat Vehicle

TECHNOLOGY AREAS: Ground/Sea Vehicles

ACQUISITION PROGRAM: PEO-Land Systems, PM Advanced Amphibious Assault (PM-AAA)

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a quiet auxiliary power unit system that provides a high power-to-weight and volume ratio capable of powering Amphibious Combat Vehicle (ACV) auxiliary electrical loads during silent watch and at-sea recovery.

DESCRIPTION: The United States Marine Corps (USMC) ACV program has a need for a very compact, quiet, and light-weight auxiliary power unit (APU) for powering on-board equipment when the main engine is off, providing silent watch capability of the ACV while ashore and at sea, and for subsystems operation during at-sea recovery.

APUs are typically powered by reciprocating or turbine engines coupled to isochronous or permanent magnet generators (Ref 1). Both engine types emit high noise levels. The aerospace industry uses turbine-powered APUs to provide power, compressed air, and environmental control. The turbine APU has the advantage of having a high power-to-weight ratio, though not as fuel-efficient, especially at non-peak loads (Ref 2). Reciprocating engines are very common, relatively inexpensive, and have a lower power-to-weight ratio. However, existing reciprocating engine APU configurations are loud and lack the power to weight/volume necessary to meet the needs of the ACV program.

Hybrid auxiliary power systems, which use a combination of power technologies, are beginning to gain acceptance, but have not been adapted to workable solutions in acoustically restrictive applications as discussed within this topic. Zero-emission fuel cells with built-in fuel reformers have recently been integrated to provide auxiliary power for over-

the-road freight trucks (Ref 3), and are expected to become price-competitive as diesel exhaust emission restrictions become effective. However, existing fuel cell systems do not operate properly when using military fuels, and have not yet been proven in austere military environments.
This topic seeks an innovative approach in the development of an APU capable of being placed and operated in a dimensionally challenging space, such that the aural signature and acoustic noise level transmitted to the vehicle interior and the exterior are at acceptable levels.

Proposed concepts shall provide 7 kilowatt (kW) continuous Direct Current (DC) power at 28 volts, with a capability to handle transient loads of up to 125% for 5 minutes, and 150% for 5 seconds, and meet Mil-STD-1332B (www.everyspec.com) DC Utility Power requirements. F24, DF-2, DF-A, or JP-8 fuel from the vehicle's on-board fuel tank will be available for use and may use the main vehicle batteries for starting and peak buffering. Concepts shall be capable of starting and operating in temperatures between -51 degrees Fahrenheit (°F) and 130°F and shall, as a system, weigh less than 440 pounds (threshold), or 220 pounds (desired). Proposed concepts shall not generate a direct sound pressure level at the vehicle interior, not including the reverberant sound field, of more than 80 A-weighted decibels (dB(A)) referenced to (re) 20 micropascals, under all loading conditions (0 to 100% loading). Proposed concepts shall not generate a sound pressure level at the exterior of the APU of more than 75 dB(A) Objective, 85 dB(A) (Threshold). Fuel consumption shall not exceed 0.5 Gallon-per-Hour (GPH) (Objective), 1.0 GPH (Threshold) at full continuous load resulting in significant fuel savings over having to run the main engine. Proposed concepts shall not exceed the following dimensions: 12"H x 18.4"W x 36"L, which excludes the starting battery or fuel tank. The APU target production cost shall be less than $59,000 (threshold), $25,000 (desired).

PHASE I: The small business will develop concepts for quiet auxiliary power system that meets the requirements stated in the description section and that is capable of powering ACV auxiliary electrical loads during silent watch and at-sea recovery. The company will demonstrate the feasibility of the concept(s) in meeting Marine Corps needs and will establish that the concept(s) can be developed into a useful system for the Marine Corps. Feasibility will be established by material testing and analytical modeling, as appropriate. The small business will provide a Phase II development plan with performance goals and key technical milestones, and that will address technical risk reduction.

PHASE II: Based on the results of Phase I and the Phase II Proposal, the small business will develop a scaled, quiet, auxiliary power system prototype for evaluation. The prototype will be evaluated to determine its capability in meeting the Marine Corps' requirements for the quiet auxiliary power system as stated above. System performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters. Evaluation results will be used to refine the prototype into a design that will meet Marine Corps' requirements. Working with the Marine Corps, the company will prepare a Phase III development plan to detail the strategy for transitioning the technology for Marine Corps use.

PHASE III: If Phase II is successful, the company will be expected to support the Marine Corps in transitioning the quiet auxiliary power system for Marine Corps use. The company will develop quiet auxiliary power unit(s) for evaluation to determine its effectiveness in an operationally relevant environment. The company will support the Marine Corps for test and validation to certify and qualify the system for Marine Corps use. The company will develop manufacturing plans and capabilities to produce the system for both military and commercial markets.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: A quiet, ruggedized, high power-to-weight/volume ratio generator is highly desirable in many markets. In particular, applications in aviation, marine, and emergency response are easily envisioned.

REFERENCES:
1. "On-Site Power Generation, A Reference Book, Fourth Edition" Boca Raton, FL, Electrical Generating Systems Association (EGSA), 2006. http://www.egsa.org/Publications/ReferenceBook.aspx

2. "Technology Characterization: Microtubines." Environmental Protection Agency, Combined Heat and Power Partnership Program, Arlington, VA, December 2008.
http://www.epa.gov/chp/documents/catalog_chptech_microturbines.pdf

3. Weissler, Paul. "Delphi truck fuel-cell APU to hit road in 2012". Society of Automotive Engineers. 12 May 2010, http://articles.sae.org/8222/

KEYWORDS: Auxiliary Power Unit; Compact Generator; Auxiliary Power; Silent Watch; ACV; Amphibious Vehicles

TPOC: Nicholas Johnston
Phone: (703)432-5155
Email: nicholas.johnston@usmc.mil
2nd TPOC: William Story
Phone: (703)784-2425
Email: william.story@usmc.mil

N151-005 TITLE: Real-Time Exploitation of Video Synthetic Aperture Radar Imagery

TECHNOLOGY AREAS: Air Platform, Sensors

ACQUISITION PROGRAM: PMA 299

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop innovative techniques to exploit Video Synthetic Aperture Radar (Video-SAR) imagery using a signature-aided non-coherent (NCD) approach in order to provide real-time detection, tracking and classification support for very slow moving targets.

DESCRIPTION: Video-SAR has proven to be a very valuable tactical tool for remote monitoring of activity in an area of interest such as a port or harbor facility. With sufficient spatial resolution it is possible to observe the movement of vehicles and even humans. However, significant operator attention and experience is required to discern the movement of slowly walking humans. Automated detection and tracking of all moving objects in the scene, but in particular a robust approach for slow walking humans, is needed. The application of Video-SAR and signature-aided NCD should facilitate the robust detection and tracking of very slow moving targets that have spatially changed their positions as a result of movement. NCD algorithms are relatively simple to implement onboard real-time processing, as well as having the potential of being fairly robust. However, the main drawback to NCD, particularly for detection of low radar cross section (RCS) targets such as humans, is the potential for high false alarm rates. On the other hand, coherent change detection should provide the complementary capability to detect dismounts, but is very difficult to implement in a robust fashion. To mitigate potential false alarms, a signature-aided tracking approach that exploits high resolution features within the NCD detections is suggested to help correlate real target tracks. The techniques should be able to leverage somewhat similar approaches used in video tracking.

PHASE I: Develop a video-SAR exploitation approach and demonstrate initial feasibility using open-source or other available radar collections. Develop a plan addressing performance metrics and integration tasks for a use on the MH-60R.

PHASE II: Develop and refine a real-time implementation of the approach suitable for demonstration on the MH-60R APS-153 radar system. Assess the performance of the approach on open-source or other suitable data collections. Complete the integration plan and include the definition of all interfaces.

PHASE III: Test and fully integrate the approach in the APS-153 radar system, as well as other candidate radar systems, and transition the technology to the Fleet and commercial applications.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The general methods developed could be applicable to a wide range of surveillance applications, including homeland security.

REFERENCES:
1. Henke, D., Magnard, C., Frioud, M., Small, D., Meier, E. & Schaepman, M. E. (2012). Moving-Target Tracking in Single-Channel Wide-Beam SAR. IEEE Transactions On Geoscience and Remote Sensing, 50(11), 4735-4747.

2. Bovolo, F., Marin, C. & Bruzzone, L. (2012). A Novel Hierarchical Approach to Change Detection With Very High Resolution Sar Images for Surveillance Applications. IEEE IGARSS, 1992-1995.

3. Nawaz, T., Poiesi, F. & Cavallaro, A. (2014). Measures of Effective Video Tracking. Image Processing, IEEE Transactions, 23(1), 376-387.

KEYWORDS: Target Detection; Synthetic Aperture Radar; Target Tracking; Radar Surveillance; Video Synthetic Aperture Radar; Non-Coherent Change Detection

TPOC: (301)342-2637
2nd TPOC: (301)342-9173

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N151-006 TITLE: Low Power, Low Cost, Lightweight, Multichannel Optical Fiber Interrogation Unit for Structural Health Management of Rotor Blades

TECHNOLOGY AREAS: Air Platform, Sensors

ACQUISITION PROGRAM: PMA 261

OBJECTIVE: Develop an innovative optical fiber interrogator of low weight, small factor, and low power draw for integration into composite rotorcraft blade Structural Health and Usage Monitoring systems (SHUMs).

DESCRIPTION: The main rotor blades and associated rotating hardware are some of the highest dynamically loaded parts found on rotorcraft. These dynamic parts have historically been hard to instrument without a significant weight penalty and are often inspected at intervals. A system capable of monitoring true strains, as well as damaging impacts during rotorcraft operation, without the usually associated weight penalties would have enormous benefits. Usage information taken from this system would enable health and usage monitoring (HUM) of the rotor system, allowing maintainers to be alerted when components are about to show signs of degradation, resulting in increased safety and reduction in unnecessary maintenance. Additionally, faster maintenance turnaround would translate into improved aircraft availability and lower life cycle costs.

Optical fiber sensors could be used for the monitoring of strain levels, vibrations, and temperature in a rotor blade. In order to perform impact detection, degradation diagnostics, and fatigue damage monitoring, the low weight of the fiber sensor, and its immunity to electrical interference, are major benefits to this sensing method. In addition, these optical fibers can be embedded into composite fiber blades during their construction, giving them a layer of protection from environmental factors. Optical fibers can measure much larger strain ranges than traditional foil strain gages. An optical fiber system could also be used to assist blade tracking. By embedding these sensors into a rotor blade, the safety and cost of rotorcraft operations would be greatly improved. This condition based maintenance functionality is in line with current Navy programs like the CH-53K Integrated Hybrid Structural Management Systems (IHSMS), which is an effort aimed at developing rotorcraft airframe and rotor system Structural Health Management (SHM) capabilities.

The sensor interrogator is the major component within the optical fiber system which drives the weight and power requirements. Mission-ready helicopter load-outs avoid slip rings due to their unnecessary weight and complexity; a fiber system, therefore, must be able to use the limited power available from energy harvesting methods. With a weight of several pounds (and high power requirements), commercial interrogator units are unusable in the dynamic rotorcraft environment. An interrogator that is much lighter and smaller than these commercial units is desired. The system must be of low volume (less than 200 cm3) and weight (no greater than 0.33 kg), and be capable of interrogating an optical fiber containing 15 sensing locations in a single blade, and have no moving parts. The sensor interrogator should also be able to withstand the high vibrations and loads found in a Naval rotor system in which it will be installed. The interrogator must be able to accurately resolve the large blade strains produced by a helicopter blade, and be able to obtain data from each sensor at a rate of at least 1 kHz. The interrogator must also be able to operate efficiently, drawing no more than 3 watts of power.

PHASE I: Determine and demonstrate the feasibility of a multi-function optical fiber sensor system that can, at minimum, meet all of the stated requirements listed in the description. For Phase I efforts only, the requirements for the system can be scaled up to 30 sensing locations or down to 5 sensing locations as long as all of the other requirements (power draw, size, weight, etc.) scale similarly.

PHASE II: Develop and mature technologies, fabricate and deliver a prototype of the proposed optical fiber sensing system capable of surviving in the vibratory environment similar to one found on a Naval helicopters rotor system, and demonstrate its ability to meet the stated requirements.

PHASE III: Integrate the optical fiber sensing system, resulting from the Phase II effort, on a Navy helicopter rotor equipped with wireless sensor and power systems. Perform field testing to show the robustness of the system and to resolve issues regarding the interrogator integration with embedded sensors and on-board communication networks. Transition into use on appropriate Navy platforms and commercial applications.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Potential to integrate into structural health usage management/monitoring systems (HUMS) for use in engineering projects such as buildings, bridges, robotics, commercial aviation and helicopters.

REFERENCES:
1. Annamdas V.G.M., Yang Y. & Liu H. (2008). Current development in fiber Bragg grating sensors and their Applications. Proceedings of SPIE, San Diego, California, USA, 6932, 69320D (paper no: 6932-15). http://www.academia.edu/2195126/Current_development_in_fiber_Bragg_grating_sensors_and_their_applications

2. Todd M.D., Johnson G.A. & Vohra S.T. (2001). Deployment of Fiber Bragg Grating-Based Measurement System in a Structural Health Monitoring Application. Smart Materials and Structures, 2001, 10, 534-539. http://iopscience.iop.org/0964-1726/10/3/316/pdf/0964-1726_10_3_316.pdf

3. MIL-STD-810G, Environmental Engineering Considerations and Laboratory Tests (31 Oct 2008).

KEYWORDS: Wireless; Blade; Uav; Hums; fiber interrogator; strain monitoring

TPOC: (301)342-0097
2nd TPOC: (301) 342-3632
3rd TPOC: (301)342-8396

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N151-007 TITLE: <u>Sensory System for the Transition from Aided to Unaided Vision During Flight to Mitigate Spatial Discordance</u>

TECHNOLOGY AREAS: Air Platform, Human Systems

ACQUISITION PROGRAM: JSF-Sus

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a system to seamlessly transition from aided to unaided vision while performing night operations.

DESCRIPTION: When pilots transition from aided to unaided vision during flight, the number of visual cues that can be used as reference for aircraft attitude is greatly reduced. If this occurs during nights with very low ambient light, spatial discordance can occur. Rapid transition from aided to unaided sight reduces the number of peripheral visual cues from many to few which can lead to spatial disorientation and unsafe flight. Dark adaptation, or the ability to perceive low-level light, can take as long as half an hour [2]. Other cues that indicate the attitude of the aircraft must be made present to mitigate the effects of night-vision aides on the visual system, where a light adapted eye must quickly transition to extremely dark conditions.

A lack of sufficient peripheral visual orientation cues may lead to a number of spatial discordance issues (e.g., black-hole effect) [4]. Peripheral visual cues are reduced during a dark night or white-out (atmospheric or blowing snow) conditions. In either case, it is the lack of peripheral visual cues that lead to disorientation. Another situation in which pilots require peripheral visual cues is when approaching and closing in on another aircraft (e.g., in-flight refueling). Pilots use peripheral cues to estimate their relative position to the Earth and the aircraft to which they are approaching [4]. Without this peripheral information, as it occurs in extremely dark conditions, closing in on another aircraft becomes significantly more challenging and potentially dangerous. Currently, pilots rely on the plane's attitude indicator, a visual representation of the plane's position relative to the horizon, when experiencing spatial discordance. This visual cue provides information to the foveal visual field and does not take advantage of the benefits of cuing peripheral sensory receptors. Although this information is quite salient in the foveal visual field, pilots report dismissing this information since the vestibular cues they experience provide more compelling evidence of their (incorrect) spatial orientation.

As previously mentioned, peripheral visual cues are a major contributor to maintaining straight and level flight and avoiding spatial discordance. More recent research, however, has demonstrated that spatial information can be improved with multimodal (i.e., vision, hearing, tactile) stimulus presentation [1]. With the appropriate combination of more than one stimulus modality, humans can orient themselves more quickly and accurately than with the activation of one sensory modality alone [1].

Technology with the ability to provide a pilot transitioning from aided to unaided flight with additional stimuli to maintain a straight, level, and safe flight is needed. This technology should be able to be activated at the pilot's discretion and suitable for different platforms that have different requirements and constraints. At a minimum, however, this project should be applicable to Navy 5th generation fighter aircraft. Since the only 5th generation fighter in the current inventory is the F-35 Lightning II, this technology should be compatible with the current cockpit design and successfully integrate with the baseline pilot-vehicle interface (PVI). If possible, the technology should extend to previous generation fighters and other aircraft (e.g., helicopters). Collaboration with original equipment manufacturers (OEMs) in all phases is highly encouraged to assist in defining aircraft integration, commercialization requirements, and providing test platforms. The stimulation of more than one sensory system (e.g., vision, hearing) is not required, but only illustrated as an example.

PHASE I: Based upon stated needs in the description, develop an approach that demonstrates the ability for a pilot to orient themselves more quickly and accurately than current technology allows. Provide documentation that demonstrates the suitability of the design into representative platforms and mission environments. A proof-of-concept demo should be performed along with a Technology Readiness Level (TRL)/Manufacturing Readiness Level (MRL) assessment.

PHASE II: Develop the system into a prototype, perform further testing in a relevant environment, and demonstrate performance in a simulated or actual flight environment. During this phase, performer should engage appropriate PMA, PEO, and/or appropriate contract support (e.g., Joint Program Office (JPO), Lockheed Martin (LM), etc.) to discuss options for in-flight test in Navy aircraft. If this is cost- or time-prohibitive, testing in commercial aircraft is acceptable. Tests during this phase should demonstrate the superiority of the new system compared to the standard avionics used during spatial discordance. Feasibility of aircraft/fighter integration should also be demonstrated. TRL/MRL assessment should be updated.

PHASE III: Transition the system into the Fleet by providing the system to appropriate testing-and-evaluation (T&E) programs. Contacts described in Phase II should be aware of technology by Phase III and providing in-flight (T&E) during Phase III. Concurrent with in flight T&E, performer should develop commercialization plans for the private sector.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This system would be useful in the private sector as spatial discordance has been found to be a large contributor to civilian mishaps as well.

REFERENCES:

1. Calvert, G. A., Spence, C., & Stein, B. E. (2004). The Handbook of Multisensory Processes. MIT Press.

2. Bear, M. F., Connors, B. W., & Paradiso, M. A. (2006). Neuroscience: Exploring the Brain 3rd Edition. Lippincott, Williams, & Wilkins.

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5. DoD 5000.2-R, Appendix 6, pg. 204., Technology Readiness Levels and Their Definitions. http://www.acq.osd.mil/ie/bei/pm/ref-library/dodi/p50002r.pdf

6. Manufacturing Readiness Level (MRL) Deskbook, May 2011. http://www.dodmrl.com/MRL_Deskbook_V2.pdf

KEYWORDS: spatial orientation; spatial discordance; peripheral cues; vision; multisensory; sensory system

TPOC: (301)757-8490
2nd TPOC: (407)380-4769

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N151-008 TITLE: Innovative, Low Cost, Highly Durable Fuel Bladder for Naval Applications

TECHNOLOGY AREAS: Air Platform, Materials/Processes

ACQUISITION PROGRAM: PMA 265

OBJECTIVE: Develop an innovative, low cost, lightweight, highly durable fuel bladder for naval applications through a quicker, more repeatable manufacturing process.

DESCRIPTION: A fuel bladder is a flexible internal aircraft structure containing fuel to be provided to the engine(s). The fuel bladder must be foldable so that it can be installed through small cavity openings on the aircraft. Metal fittings are incorporated into the fuel bladder to allow interface to the aircraft fuel system. The bladder must also be durable enough to prevent a rupture of the bladder and fuel leakage from flight or maintenance induced stresses. Quality fuel bladders are imperative for the safety of our warfighters. Any fuel leaks during operational flight lead to a risk of fire, which could result in the loss of aircraft and crew. On many platforms, the Navy’s demand for fuel bladders is higher than the rate that the current fuel bladder manufacturer is able to supply. Additionally, the state of the art in fuel bladder manufacturing is a handmade artisan dependent process that can take up to 60 days to complete. This process is subject to human error, often requiring significant rework of the finished product, which results in expensive end products and long build times. This rework can include, but is not limited to, repairs such as patches, buffing, and fitting replacement.

An innovative, lightweight fuel bladder material and/or process that will decrease fuel bladder costs and improve product quality is needed. The result should be a quicker, more repeatable manufacturing process, and should increase fuel bladder durability by allowing for high puncture resistance, abrasion resistance and tensile strength, while maintaining the required flexibility. Proposed designs must be compatible with any fuel used by the Navy, including JP-5, commercial Jet A (with military additives) and a 50/50 blend of current jet fuel and bio-derived fuel. Proposed designs must also have self-sealing capability. A production representative fuel bladder must be constructed from the proposed materials. A more consistent material and process will yield higher quality fuel bladders, which will help reduce the downtime of aircraft, thus improving the capability of the warfighter.

PHASE I: Develop novel approaches for an innovative, low cost, lightweight fuel bladder materials and manufacturing process that are highly durable and acceptable for naval applications. Identify concepts and methods to be used to manufacture this new technology and demonstrate the feasibility of the recommended approach through the fabrication of a simple coupon or tank element. Modeling & simulation and/or coupon testing should address the ability of the material to meet the strength and performance requirements as specified in either MIL-DTL-5578 or MIL-DTL-27422.

PHASE II: Develop and demonstrate prototype fuel bladders using materials and processes developed under the first phase of this program. Validate, through testing, that the processes and materials can meet the “Phase I” of the qualification requirements of either MIL-DTL-5578 or MIL-DTL-27422. Demonstrate that the material and process can be modified to meet the requirements of MIL-DTL-6396 and either MIL-DTL-5578 or MIL-DTL-27422. Develop a production representative fuel bladder.

PHASE III: Validate and verify that the developed technology can reliably contain fuel in a low-cost, durable, lightweight, aircraft representative fuel bladder. Validate, through testing, that the processes and materials can meet the “Phase II” of the qualification requirements of MIL-DTL-5578 or MIL-DTL-27422. Demonstrate that the material and process can be modified to meet the “Phase II” of the requirements of MIL-DTL-6396 and either MIL-DTL-5578 or MIL-DTL-27422. Transition technology for implementation on existing fixed or rotary wing aircraft.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Fuel bladders are utilized on a majority of Navy, Marine, Army, and Air Force aviation platforms, as well as throughout the commercial industry. This topic has the potential for interoperability, since the same material lay-up and manufacturing process can be utilized for fuel bladders across many military and commercial platforms.

REFERENCES:
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2. MIL-DTL-5624V (2013). DETAIL SPECIFICATION: TURBINE FUEL, AVIATION, GRADES JP-4 and JP-5 <http://www.everyspec.com/MIL-SPECS/MIL+SPECS+(MIL-DTL)/MIL-DTL-5624U_5535/>

3. MIL-DTL-5578D (2008). DETAIL SPECIFICATION: TANKS, FUEL, AIRCRAFT, SELF-SEALING. <http://www.everyspec.com/MIL-SPECS/MIL-SPECS-MIL-DTL/MIL-DTL-5578D_13567/>

4. MIL-DTL-27422F (2014). DETAIL SPECIFICATION: TANK, FUEL, CRASH-RESISTANT, BALLISTIC-TOLERANT, AIRCRAFT <http://www.everyspec.com/MIL-SPECS/MIL-SPECS-MIL-DTL/MIL-DTL-27422F_49706/>

KEYWORDS: Bladder; Durability; Fuel Cell; Fuel tank; leakage; fuel containment

TPOC: (301)757-7397
2nd TPOC: (301)342-8936

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N151-009 TITLE: <u>Novel Isogeometric Analysis Based Automation of High-Fidelity Finite Element Analysis Model Creation from Computer Aided Design</u>

TECHNOLOGY AREAS: Air Platform

ACQUISITION PROGRAM: PMA 274

OBJECTIVE: Create a novel tool that uses isogeometric analysis techniques to integrate computer aided design (CAD) and finite element modeling (FEM) to increase the efficiency and automation of the development of a high fidelity analysis model of structural assemblies for design and repair optimization.

DESCRIPTION: A clear gap exists between the CAD files generated by designers and the analysis suitable geometries used in finite element analysis (FEA) codes. The CAD to FEA and FEA to CAD transition process is inefficient, laborious, and can introduce inaccuracies through the simplification of design features. The ability to automatically create high fidelity analysis models of structural assemblies is not available. Currently, every design iteration requires analytical models to be revised. Furthermore, changing core geometry through repairs drives the need for an updated CAD model. Using one model as the basis for design and analysis significantly reduces the time consuming process of model revision cycles.

Isogeometric analysis methods incorporating non-uniform rational B-spline (NURBS) modeling have shown considerable promise in terms of utilizing a single geometric CAD model which can be employed directly as an analysis model. T-spline extensions of NURBS modeling have allowed for local refinement and coarsening of a given model. Furthermore, isogeometric analysis is clearly advantageous in terms of reduced computational time and increased solution accuracy per degree-of-freedom over standard low-order finite element analyses.

An isogeometric modeling tool is sought that will increase the automation in the process of creating a high fidelity analysis model from CAD files (e.g. Computer Aided Three-dimensional Interactive Application (CATIA) files) or laser scanned surface digitizations. The analysis model will primarily be used for repair analysis including metallic or composite structures. The process should also facilitate transfer and integration of data amongst both design and analysis regimes. The tool should be applicable to aircraft modeling, structural improvement/development and data integration efforts. Ultimately, this tool should facilitate the integration of design with all required supporting analysis to determine structural integrity (i.e. static strength, fatigue and damage tolerance).

PHASE I: Develop and conceptually demonstrate the proposed isogeometric analysis approach to integration of CAD and finite element modeling. Demonstrate feasibility of applying this approach for structural analysis applications on a realistic, complex part and outline approach for further development in Phase II.

PHASE II: Develop a prototype tool used to increase automation in the creation of high fidelity analysis models using isogeometric analysis. Demonstrate use of the prototype tool through creation of an analytical model of selected structural components and compare structural response under various Navy approved test conditions to existing data, which will be provided as Government Furnished Information.

PHASE III: Implement validated algorithms and processes into an analysis tool that can be used for structural analysis applications. Demonstrate capability to incorporate repairs and structural optimization. Refine the prototype analysis tool into a released version of software. Develop a plan to determine the effectiveness of the software in an operationally relevant environment. Support the Navy with certifying and qualifying the system for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Most designs, modifications and repairs go through several iterations of computer aided design and finite element analysis modeling. The isogeometric analysis technique can be applied on any of these to significantly reduce the time consuming and labor intensive process of model revision cycles with the advantage of increased solution accuracy per degree-of-freedom as compared to standard low-order finite element analyses.

REFERENCES:
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3. Takizawa, K. & Tezduyar, T. E. (2012). Flapping Wing Aerodynamics of an Actual Locust. Bulletin for the International Association of Computational Mechanics Expressions, 32(12), 2-5.

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KEYWORDS: Computer Aided Design; Modeling; Finite Element; Isogeometric; Structural Analysis; Adaptive Meshing

TPOC: (301)757-2427
2nd TPOC: (301)342-8509

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N151-010 TITLE: Development of 7050 T-74 Aluminum Alloy Alternative for use in Additive Manufacturing (AM) Systems

TECHNOLOGY AREAS: Air Platform, Materials/Processes

OBJECTIVE: Develop and demonstrate a novel aerospace aluminum alloy for use in powder bed, powder fed, or wire fed additive manufacturing (AM) systems, which exhibits comparable performance of conventional 7050 T-74 aluminum alloy.

DESCRIPTION: Additive manufacturing has the ability to become game changing in the fabrication of components for use in Naval Aviation with the potential to enhance operational readiness, reduce total ownership cost, and enable parts on demand manufacturing. The technology has progressed over the years (Ref 1-4); however, the acceptance of AM to produce structural components for Navy aircraft applications is still lagging. Many areas require technology development including the formulation of tailored aluminum alloys which can be utilized in the production of aircraft components that exhibit the same mechanical properties of aluminum 7050 T-74 alloys. Aluminum 7050 T-74 alloys underwent extensive development specifically for use in aircraft applications and required years of refinement to meet performance specifications. The development of a similar class of alloys applicable to AM requires knowledge and understanding of the effects of processing parameters on material performance. Innovative aluminum alloys are sought that would be utilized in AM for the production of Navy aircraft components.

PHASE I: Develop an innovative aluminum alloy suitable for use in an AM system, which has the potential to meet or exceed the performance of conventional 7050 T-74 alloys. Demonstrate feasibility of the developed alloy by fabricating coupons and generating limited test data, such as static and fatigue properties for comparison.

PHASE II: Fully refine the formulation of the aluminum alloy developed under Phase I and demonstrate the suitability of the alloy to be utilized by the fabrication of a small but complex shaped component. Perform limited testing on the component to assess its performance. Initiate the development of a materials properties database including fatigue dependent allowables in support of the qualification of the alloy for AM of Navy aircraft components.

PHASE III: Complete the development of the alloy material property database, including B-basis allowables, to fully characterize material performance. Perform validation and verification on the developed alloy ensuring it can be utilized for the production of Navy aircraft components by performing a complete component test program. Transition the developed alloy to appropriate military programs or commercial manufacturing facilities.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Additive manufacturing (AM) is utilized throughout commercial industry for prototype development and part production. The technology developed would have applicability to the automotive industry and commercial aviation manufacturing firms.

REFERENCES:
1. Herderick, E., Additive Manufacturing of Metals: A Review, Proceedings of MS&T_11, (2011). Additive Manufacturing of Metals, Columbus, OH.

2. Metallic Materials Properties Development and Standardization (MMPDS-07), Federal Aviation Administration (April 2012).

3. Metals Handbook Desk Edition, ASM International, 1985.

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KEYWORDS: Additive Manufacturing; Aluminum Alloys; aluminum 7050 T-74; Materials Processing; processing parameters; mechanical properties

TPOC: (301)342-4078
2nd TPOC: (301)342-8003

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N151-011 TITLE: Compact Deep Vector Sensor Array

TECHNOLOGY AREAS: Air Platform, Sensors, Battlespace

ACQUISITION PROGRAM: PMA 264

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a deep-deployed array of vector sensors for use in an expendable sonobuoy system.

DESCRIPTION: Arrays of vector velocity sensors provide major system gains over legacy arrays of omnidirectional hydrophones in bottom moored configurations. For example, gains against ambient noise can be realized, the left-right ambiguity can be eliminated, and sensitivity nulls can be steered towards an interfering source making much quieter targets detectable. Deploying such acoustic sensing systems for use at extremely deep depths close to or on the ocean bottom (below critical depth) in convergent zone type environments has garnered recent interest in the Navy [1-3]. The advent of highly sensitive, compact directional sensors made possible by new transducer materials is a key enabler for this performance enhancement [2]. Recent investigation of the ambient noise structure in the deep ocean [3] suggests that a passive directional sonobuoy system covering the band from 5 to 500 hertz (Hz) would be of interest.

A sonobuoy array composed of a combination of omnidirectional and biaxial/triaxial sensors with an electronic noise floor of 40 decibels relative to 1 micropascal per root-hertz (dB/uPa/rtHz) is thought to be well suited for this application, taking into account possible inherent array gains against vertical anisotropic noise. The array design should be able to be deployed and operated at a depth of up to six kilometers. It should achieve nominal gains against noise of 15 dB (threshold) to 20 dB (objective) up to the 300 Hz region (can include gains associated with a combination of operational depth and array gain). The required gain against noise should be measured relative to average noise at shallow water depth, based upon the Ambient Noise Directionality System (ANDES) model [4].

The array should be capable of operating at a voltage of 5.0 volts-Direct Current (VDC) with a maximum current draw of 70 milliamps (mA). The array package must be less than 10 inches in height, no greater than 4.5 inches in diameter, and less than 15 pounds in weight (volume/weight constraint should not include power source). Because of the expendable nature of sonobuoy systems and the potential number of vector sensor elements required to realize effective gains, cost-effectiveness will also play a role in determining an acquisition choice.

PHASE I: Develop an initial conceptual design for a small inexpensive velocity sensor array, to include number and type of sensors, sensor spacing, and self-noise remediation (risks, limitations, proposed solutions). Perform modeling and simulation activities to evaluate prospective candidate arrays in realistic noise fields for various sites, sensors and depths.

PHASE II: Develop, construct, and demonstrate the operation of a prototype array through over-the-side testing utilizing electronically generated broadband and narrowband signals. Validate that the over-the-side prototype meets design goals. Provide signal processing needed to demonstrate array performance. Conduct performance predictions, design refinement, and selective hardware maturation for the high-risk components identified in Phase I.

PHASE III: Develop a production design of Phase II solution for integration into full sonobuoy system. Demonstrate full operational functionality in Navy-supported test scenarios. Transition the developed technology for fleet use and provide a detailed supportability plan.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Use of these sensors has potential applications in seismology, marine mammal detection, and terrorist security systems.

REFERENCES:
1. Urick, R. J. (1996). Deep-Sea Paths and Losses: A Summary. In D. Heiberg & J. Davis, Principles of Underwater Sound (3rd ed.) (p. 195). New York: McGraw-Hill Book Company.

2. Holler, R. A., Horbach, A. W., & McEachern, J. F. (2008). The Ears of Air ASW: A History of U.S. Navy Sonobuoys. Warminster: Navmar Applied Sciences Corporation.

3. McEachern, J. F., McConnell, J. A., Jamieson, J., and Trivett, D. (2006). ARAP – Deep Ocean Vector Sensor Research Array. MTS/IEEE OCEANS 2006, 1-5. doi:101.1109/OCEANS.2006.307082

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KEYWORDS: Passive; Asw; Sonobuoy; Vector Sensor; Reliable Acoustic Path; Deep Ocean

TPOC: (301)757-3694
2nd TPOC: (301)757-5720

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N151-012 TITLE: Innovative Approach to Rapidly Qualify Ti-6Al-4V Metallic Aircraft Parts Manufactured by Additive Manufacturing (AM) Techniques

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: PMA 261

OBJECTIVE: Innovative approach to rapidly qualify Ti-6Al-4V metallic aircraft parts manufactured by Additive Manufacturing (AM) techniques

DESCRIPTION: Based upon recent advances in AM, techniques are being developed to manufacture parts from metallic alloys currently used on Naval aircraft (Ref 1-3). Parts manufactured by AM are near net shape, with the ultimate goal to be able to use them on aircraft with minimum machining or post processing.

Many aircraft parts are built in small production runs when compared to consumer components. AM is well suited to these low volume parts, allowing them to be manufactured without the need to setup and break down production lines, manufactured as they are needed at the point of consumption, thus reducing the number of expensive parts in the supply chain. Ultimately, the digital description of an aircraft component will be stored electronically and downloaded to an AM machine to print the needed part, rather than physically moving the parts around the globe. This quick turnaround will enhance the Navy's readiness level and reduce costs. AM may also facilitate innovative design and the creation of complex parts that cannot be fabricated by conventional methods.

One issue that is currently limiting the utility of AM is the qualification of metal parts manufactured using AM techniques. The material properties of the parts manufactured using AM must be understood and must be repeatable if they are to be used in a safety critical aircraft environment. There is a need to understand how the AM material process variables (i.e. laser power, scanning speed, distance between scanning lines, thickness of deposited layers, energy density, build orientation, cooling rate, powder size and size distribution, later beam width, etc.) impact the microstructure and hence the related mechanical properties of the alloy.

The traditional building block approach (Ref 1-3) for material qualification will hinder AM's widespread use due to its high cost and long timeline. An innovative approach to qualify Ti-6Al-4V metal AM parts for use on Naval aircraft is sought. For example, models may be developed that can dramatically shorten the traditional certification process, or new materials testing processes or methods may be developed to rapidly validate the reliability of metal AM part properties. Other approaches will also be considered.

PHASE I: Develop innovative concepts, processing methodologies and tools that contribute to the rapid qualification of Ti-6Al-4V metallic AM parts. The concept may provide a complete qualification technique, may contribute to a step in the qualification process, or may support qualification.

PHASE II: Further develop and finalize the concept, processing methodology and tool from Phase I. Demonstrate the concept and show how it contributes to the rapid verification of the material microstructure and mechanical properties of representative Ti-6Al-4V metallic AM parts.

PHASE III: Deliver a capability that contributes to the rapid qualification of a broad range of T-6Al-4V metallic AM parts for military aviation and civilian applications.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: These new approaches can be used to accelerate the FAA certification process as well as the NAVAIR process. Fast qualification will promote a wider acceptance of AM technology within both the military and commercial sector.

REFERENCES:
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KEYWORDS: Additive Manufacturing; Modeling; Metallic; Qualification; Microstructure; Materials Processing

TPOC: (301)342-4078
2nd TPOC: (301)342-8011

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N151-013 TITLE: Deep Long Life Passive Sonobuoy Sensor System

TECHNOLOGY AREAS: Air Platform, Sensors, Battlespace

ACQUISITION PROGRAM: PMA 264

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a deep, long life, passive sonobuoy sensor system that can be deployed by aircraft and used for undersea surveillance.

DESCRIPTION: The Navy is becoming increasingly interested in deploying acoustic sensing systems below critical depth in the ocean close to or on the ocean bottom in convergent zone type environments [1]. At these depths the ambient noise structure and sound propagation physics are unique [2] and have the potential to be exploited by future undersea surveillance systems. The concept of utilizing deep sonobuoy systems is not new; in the 1970’s there were efforts to place sensors deep in the ocean. Two sonobuoy concepts were considered: an On-the-Bottom (OTB) Directional Frequency Analysis and Recording (DIFAR) and a 14,000 feet Deep Suspended DIFAR (DSD) [3]. Recent investigation of the ambient noise structure in the deep ocean [2] suggests that a passive directional sonobuoy system covering the band from 5 to 500 hertz (Hz) would be of interest. When the sea state is calm and there is little distant shipping, the ambient levels are nominally 40 to 50 decibel (dB) are 1 microPascal^2/Hz [2]. A sonobuoy array composed of a combination of omnidirectional and biaxial sensors with an electronic noise floor of 40 dB/microPascal^2/Hz is thought to be well suited for this application particularly in view of array gains that are possible as a result of the vertical anisotropic noise field. What is desired is an A-size sonobuoy which can be deployed from an aircraft and operate at or close to the ocean bottom (up to 6 km). The sonobuoy will have a minimal operational life of 3 to 14 days and be capable of storing data until commanded to exfiltrate the data to an aircraft or periodically to an over the horizon location. It is expected that In-Buoy Signal Processing (IBSP) will be needed to reduce the data transfer rate and in-buoy data storage. IBSP will, as a minimum, consist of acoustic beamforming (possibly adaptive) and both narrowband and broadband processing. For data exfiltration from the array up to the radio frequency (RF) communication link, consideration should be given to data rates from the array, pressure and temperature variations across depths as well as survivability. It is expected that array design, long life, deep depth survival and data exfiltration will require innovative solutions because of the A-size packaging constraints [4].

The RF communication link should conform to the receive capability of the air platform which is composed of Continuous Phase Gaussian Frequency Shift Keying (CPGFSK) waveform of 320 kilobits per second (kbps) for which 288 kbps can be acoustic data.

Note that A-size refers to the standard U.S. Navy Sonobuoy form factor or a right-circular cylinder having a diameter (D), length (L), and maximum weight (W) of D=4.875 inches, L=36 inches, and W=39 pounds.

PHASE I: Develop approaches, and perform modeling and simulation activities to evaluate prospective designs associated with the sensor type(s), array, telemetry, packaging, deployment, and self-noise remediation within the overall architecture of an A-size sonobuoy.

PHASE II: Conduct performance predictions, design refinement, and selective hardware maturation for the high-risk components identified in Phase I, and develop a prototype sonobuoy.

PHASE III: Develop a prototype sonobuoy of the Phase II solution. Demonstrate full operational functionality in Navy-supported test scenarios. Transition the developed technology for Fleet use and provide a detailed supportability plan.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Demonstrate full operational functionality in Navy-supported test scenarios. Transition the developed technology for Fleet use and provide a detailed supportability plan.

REFERENCES:
1. Urick, R. J. (1996). Deep-Sea Paths and Losses: A Summary. In D. Heiberg & J. Davis, Principles of Underwater Sound (3rd ed.) (p. 195). New York: McGraw-Hill Book Company.

2. Gaul, R. D., Knobles, D. P., Shooter, J. A., & Wittenborn, A. F. (2007). Ambient Noise Analysis of Deep-Ocean Measurements in the Northeast Pacific. IEEE Journal of Oceanic Engineering, 32(2), 497 – 512. doi:10.1109/JOE.2007.891885

3. Holler, R. A., Horbach, A. W., & McEachern, J. F. (2008). The Ears of Air ASW: A History of U.S. Navy Sonobuoys. Warminster: Navmar Applied Sciences Corporation.

4. McEachern, J. F., McConnell, J. A., Jamieson, J., and Trivett, D. (2006). ARAP – Deep Ocean Vector Sensor Research Array. MTS/IEEE OCEANS 2006, 1-5. doi:101.1109/OCEANS.2006.307082

KEYWORDS: Passive; Asw; Sonobuoy; Vector Sensor; Reliable Acoustic Path; Deep Ocean

TPOC: (301)757-3694
2nd TPOC: (301)757-5720

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N151-014 TITLE: Automated Test Program Set Analysis for Maintenance Data Metrics Generation

TECHNOLOGY AREAS: Information Systems, Materials/Processes, Electronics

ACQUISITION PROGRAM: PMA 260

OBJECTIVE: Develop a novel method for extracting usage metrics from test program set (TPS) source code and automated test equipment (ATE) logs.

DESCRIPTION: The Consolidated Automated Support System (CASS) family of testers currently hosts more than 1,500 TPSs in support of the testing and repair of avionics and weapon system units under test, spanning numerous aircraft platforms. Several hundred additional TPSs are also slated for development. This has resulted in a large pool of TPS code and associated data, stored in the Navy's Automatic Test System (ATS) Source Data Repository.

This data is viewed as an untapped resource to aid in ATS planning and support. The ability to relate test instrument capabilities to TPS source data and ATS usage data would provide a comprehensive look at how avionics maintenance is performed. Data mining on this comprehensive data set could serve to expose run-time inefficiencies or under- and over-utilized test equipment (or specific capability ranges within a piece of equipment), providing significant benefit to the selection of new ATS components during replacements and upgrades. Broad questions could be answered about ATS component capabilities, including not only the frequency of their use but also the manner. Additionally, such an analysis could identify economic targets of opportunity for the deployment of new and innovative test techniques.

Complexities in the execution of TPSs present frequent challenges to the analysis of the data sets. TPS instrument settings can be variable, not hard coded. These variables are often set procedurally but other times via manual input from the ATS user. This product should be capable of assigning TPS variables regardless of their dependencies. Development of such a capability poses a technical challenge that is part test simulation and part data mining/analysis. Once every TPS can be simulated and their results archived, a total envelope of all ATS instrument usage can be generated.

PHASE I: Define and develop a concept for the aggregation and analysis of ATE and TPS data. The concept must apply to PMA-260's CASS family of testers (CASS, Reconfigurable Transportable CASS, and electronic CASS [eCASS]) but may provide a complete data metrics generation concept or contribute to a step in the aggregation and mining of such data.

PHASE II: Further develop the concept defined in Phase I. Demonstrate the ability to simulate TPSs while storing the values of any variable instrument settings, until such time that a comprehensive set of parameters for each variable are defined. Verify these parameters against log files from actual TPS runs on CASS.

PHASE III: Complete testing and transition technology to PMA-260 ATE and TPS development and acquisition support processes or appropriate platforms and users.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The testing of complex electronic assemblies is not just limited to Navy ATS. The concept product developed through this SBIR would be easily applicable to other Department of Defense (DoD) ATS, with potential further applications to commercial avionics test equipment or non-avionics electronics test in the private sector.

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2. United States DoD. (2004). DoD automatic test systems handbook. Retrieved from http://www.acq.osd.mil/ats/DoD_ATS_Handbook_2004.pdf

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KEYWORDS: Data Mining; ATE; TPS; ATS; metrics; Avionics Maintenance

TPOC: (732)323-1203
2nd TPOC: (732)323-4877

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N151-015 TITLE: Minimized Space, Weight and Power Network Architecture Solution

TECHNOLOGY AREAS: Air Platform, Information Systems

ACQUISITION PROGRAM: PMA 231

OBJECTIVE: Develop a single card/box network solution with minimal Space, Weight, and Power (SWaP) requirements that is compatible with existing aircraft data links architecture and provides data routing, switching, optimization, security, and monitoring.

DESCRIPTION: Advanced airborne sensor systems provide highly detailed and accurate data for detection, identification and targeting. This data can be very valuable to distributed platforms that are connected together in Internet Protocol (IP) and other networks. Radar, signals intercepts, imagery, and other electromagnetic data can be highly valuable when shared between multiple platforms simultaneously. Data fusion and data correlation systems can build highly accurate tactical situational awareness when aggregating data from multiple sensors, but data must be aggregated in real-time or near-real-time over airborne networks to enable these systems and contribute to the Integrated Warfighting Capability (IWC) of the Navy.

Using multiple network paths increases the availability of real-time communications and can increase the potential throughput or quantity of data that can be shared. Aircraft currently use both satellite and line-of-sight (LOS) links to move data between aircraft and shore and surface platforms. IP networking over multiple paths is a widely used tool for interconnecting platforms. Recent advances in networking technology have enabled IP networks to work more effectively with load balancing over multiple links, dynamic failover, data prioritization, acceleration and optimization. Networking technology has also reduced space, weight, and power requirements with the ability to host multiple functions in a single device. Security controls have seen significant advances in the commercial environment with improved firewall, encryption, and data segregation capabilities. Network protocols have realized advances that can minimize overhead and increase useful throughput. Radio-aware protocols are able to shape traffic more effectively to improve the ability of the network to react to dynamic connections in variable environments. Employment of these advanced networking techniques will contribute to a more secure and flexible networking solution.

Develop an advanced networking capability that improves the ability of aircraft to share sensor data over networks with higher throughput, lower latency and increased reliability. The resulting solution should be ruggedized to meet military avionics requirements including: MIL-STD-704F (power), MIL-STD-461F (electromagnetic compatibility), and MIL-STD-810G w/ CHANGE 1 (environmental: temperature, vibration, shock, aircraft carrier catapult launch and arrested landing). The SWaP footprint should be minimized and designed to fit within existing aircraft. Rack mounted hardware, single board computers, and Air Transportable Rack (ATR) chassis components may be considered for the hardware design. Specific hardware configuration will focus on E-2D. Software-based networking solutions may also be considered for this SBIR. Advanced development of software or hardware solutions should include multiple functional areas including routing, switching, optimization, security and monitoring.

Combination of these functions into a networking solution that can transition to multiple aircraft installations would be highly desirable to the Navy and enable multiple aircraft or other mobile platforms to share information in a distributed environment.

PHASE I: Investigate, analyze and design a robust multi-link networking solution for aircraft utilizing discrete components for routing, switching, optimization, security and monitoring. Conduct a feasibility analysis of various physical footprints and explore the minimal SWaP footprint required to maintain network connectivity with other Navy platforms. Identify Concepts for Operations (CONOPS) that will be impacted by utilization of the system. Conduct a business case analysis of transitioning multiple platforms to the system.

PHASE II: Develop, demonstrate and validate a small form-factor prototype that embeds the key networking functions in a single device. Test the prototype in a laboratory simulated operational environment and identify metrics to validate the system’s advantages over legacy network components.

PHASE III: Transition final design into an E-2D aircraft. Support the Navy with certifying and qualifying the Minimized SWaP Network Architecture Solution system and develop plans to transition to additional Navy and commercial aircraft.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Small form factor networking solutions are becoming increasingly important for industries such as software, data-centers, and/or vehicles. This innovation should deliver a low SWaP solution that is applicable to both military and commercial aircraft, land and surface vehicles, and if constructed to minimize power consumption could minimize the support tail and carbon footprint of large networks and data centers.

REFERENCES:
1. Shahriar, A.Z.M., Atiquzzaman, M., & Ivancic, W. (2010) Route Optimization in Network Mobility: Solutions, Classification, Comparison, and Future Research Directions. IEEE Communications Surveys & Tutorials, 12(1), 24-38. doi:10.1109/SURV.2010.020110.00087

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4. MIL-STD-704F, “Aircraft Electric Power Characteristics,” 12 March 2004.

5. MIL-STD-461F, “Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment,” 10 December 2007.

6. MIL-STD-810G (w/ CHANGE 1), “Environmental Engineering Considerations and Laboratory Tests,” 15 April 2014.

KEYWORDS: Optimization; Aircraft; Networking; SWaP; routing; LOS

TPOC: (301)757-7014
2nd TPOC: (301)757-6592

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N151-016 TITLE: Direct Replacement Ignition Upgrade for Present and Future Combustors and Augmentors

TECHNOLOGY AREAS: Air Platform, Ground/Sea Vehicles

ACQUISITION PROGRAM: JSF-Prop

OBJECTIVE: Develop an advanced ignition system as a direct “drop-in” replacement for in-service and/or next-generation combustor and afterburner systems.

DESCRIPTION: Widely varying operating conditions (e.g., temperature, pressure, fuel/air mixture) as well as emerging alternative fuels, present challenges to ignition of aviation combustion systems used by the DoD. In the augmentor, for example, these conditions can be exacerbated by the presence of vitiated reactants from the combustor section that have lower oxygen content and higher concentrations of carbon dioxide, oxides of nitrogen and water vapor. In addition, if a flameout occurs at high altitude, the temperature and pressure in the combustor and/or augmentor are low, which makes ignition more difficult. The appropriate amount of energy required by the igniter to start the reaction process over a wide range of engine operating conditions varies significantly due to these competing physical processes. Finally, the chemical composition of kerosene-based (e.g., JP-5, JP-8, Jet A, Jet A-1) and alternative fuels have widely varying thermo-physical properties and therefore different ignition characteristics.

As a result, many combustion systems have operating envelopes at least partially defined by the ignition limit, i.e., the boundary condition at which the ignition system is unable to provide sustained combustion. Near the limits of the operating envelope (i.e., low temperature, lean fuel/air mixtures, high altitude, and low pressure) a reduction in ignition system or other subsystem performance may lead to slow light or no-light conditions. Increased operating margins provided by the ignition system would compensate for minor subsystem deficiencies, thus reducing unscheduled maintenance that would increase maintenance intervals. This would lead to increased fleet readiness levels, reduced overall maintenance costs, and would potentially increase capabilities available to the Warfighter. Ideally, such a system would be capable of being developed as a direct replacement on existing engines with minimal modification to the current control system, mounting location, electrical buss, or the existing igniter port.

Previous testing has shown that simply increasing energy output from fielded ignition concepts yields only small performance benefits with severe durability penalties. The increased performance demands from 5th-generation and 6th-generation engines may heighten the need for increased energy at the combustor and augmentor, thus creating further durability challenges as the environment pushes material limits.

Current modeling technology uses simple empirical correlations of lean blowout (LBO) to determine ignition likelihood. Empirical models by King (1957), DeZubay (1950), Ozowa (1970), and Kiel et al. (2011) assume a global extinction parameter based on global conditions. These models imply a relationship between blowout physics and ignition physics that may be unfounded. While much recent work continues to focus on finding solutions through improving ignition models, recent empirical work has shown promise through the investigation of new approaches that address parameters to increase ignition effectiveness. Recent work at Georgia Tech (B.Sforzo. et.al. 2013 and B.Sforzo et.al. 2011) has shown that ignition energy location relative to the cross section of the flow field may be a key factor in ignition effectiveness. By projecting energy beyond what is presently possible with present ignition systems, an ignition solution providing enhanced capabilities without durability penalties may be achievable.

An ignition technology which provides an increase in performance/durability, which in turn provides some combination of improved light-off/relight capability that can be implemented as a direct replacement upgrade without modification to the engine, control system, or other subsystems is sought. This ignition system should meet current DoD performance-based specifications (JSSG-2007B).

Describe how the proposed ignition system could be an enabling technology allowing further development of 5th-generation and 6th generation engines. This ignition system should also have the ability to dynamically adapt the ignition energy content and location as needed by the engine via direct control of an advanced full authority digital engine control (FADEC) in order to further simultaneously improve the flight envelope while increasing durability/reducing maintenance.

Close collaboration with an Original Equipment Manufacturer (OEM) of gas turbine engines and aircraft ignition systems is highly encouraged to ensure successful transition of improved ignition technology following a successful Phase II effort.

PHASE I: Design and develop a retrofit or direct replacement of the proposed system concept for naval aviation applications. Detail required test facilities and measurement techniques for system validation. Demonstrate feasibility of ignition capability enhancement of the proposed approach in an appropriate environment.

PHASE II: Develop and validate an improved ignition system prototype including igniters, leads, and exciter over the representative range of operating conditions found in legacy, 5th-generation, and 6th-generation combustor and augmentor system for naval aviation applications. Develop a transition plan.

PHASE III: Complete development and transition to DoD and commercial gas turbine engine ignition system manufacturer and/or their vendors, including validation and certification testing.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The technology has the true potential for dual-use applications by improving ignition systems in legacy, 5th-generation, and 6th-generation military combustor and augmentor systems as well as civil gas turbine engines. It also has the potential for stationary combustion systems used for power generation, furnaces, and boilers.

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9. Department of Defense Joint Specification Service Guide (JSSG). (2007). Engines, Aircraft, Turbine. JSSG-2007B.

10. Wu, H, & Ihme, M. (2014). Effects of flow-field and mixture inhomogeneities on the ignition dynamics in continuous flow reactors. Combustion and Flame. 161, 9, 2317-2326. <http://www.sciencedirect.com/science/article/pii/S0010218014000662>

KEYWORDS: Combustion; Ignition; direct replacement; plasma; chemical kinetics; augmentor

TPOC: (301)757-0467
2nd TPOC: (937)255-4229

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N151-017 TITLE: Adaptive Scanning for Compressor Airfoils

TECHNOLOGY AREAS: Air Platform, Materials/Processes, Sensors

ACQUISITION PROGRAM: JSF-Prop

OBJECTIVE: Development of a commercialized measurement system for an integrally bladed rotor (IBR) and compressor blade inspection that will enable the accuracy of current commercial systems to be exceeded and will result in a reduction of measurement times.

DESCRIPTION: In the past several years, contact measurement systems have evolved from point, to line, to surface scanning methods. This evolution has led to an inherent decrease in scanning time for mapping the profile of military-sized engine IBRs from 100s of hours to less than 10 hours. In addition to contact measurement systems, there have been non-contact measurement systems that utilize optics for airfoil characterization. The contact and optical measurement methods each have their limitations. Contact measurement systems are inherently slower and are susceptible to dynamic effects such as vibration. Optical measurement systems use a line-of-sight technique which has highest integrity when performing measurements normal to the measured surface which makes small IBR measurements possessing small passages and closely spaced airfoils cumbersome. Optical techniques may be hindered by their susceptibility to characterize airfoils with high surface finish, as a smoother surface may saturate the receiving optics with diffused light. Airfoils with a “super-polished” finished are ideal for increased efficiency. A deficiency that both contact and optical methods exhibit is the inability to get accurate measurements of high-curvature entities, such as the leading and trailing edges of airfoils. It is the leading and trailing edge of airfoils that is considered the most critical with respect to geometry but also the most challenging to manufacture and thus the need for accurate inspection. Therefore, an innovative or hybrid singular system is necessary to accurately measure airfoil profiles, specifically high-curvature surfaces, while minimizing scan time.

The research will consist of two primary components. The first component of the research is system design. To increase measurement speed, it is expected that the solution will involve scanning of the desired airfoil sections that define the desired geometry. This will require extreme attention to the coordinated motion of multiple axes along with minimization / correction of geometric and positioning errors. The solution is recommended to be non-contact to eliminate speed-limiting, dynamic effects of the contact in conventional systems. The second component of the research is system control. A high-resolution, high bandwidth, non-contact probe has operating limits of angular orientation with respect to the surface being measured. Compressor airfoils have features with high curvature (e.g. leading and trailing edge) where the size of the feature is similar in magnitude to the location tolerance of the feature with respect to the overall part datum planes. These facts together mean that, in general, a multi-axis sensor path based on the nominal part geometry will not be sufficient to perform a successful measurement. A successful response will include a significant effort in the development of control algorithms including real-time signal conditioning, curve fitting, and optimization to quickly scan sections, IBRs and airfoils. These aspects of the research will certainly have implications to other applications and industries. Collaboration with engine/blade/IBR manufacturers to define system requirements and support commercialization is highly encouraged during all phases of the program.

PHASE I: Feasibility of measurement precision and measurement reduction time should be exhibited. Conceptual design for the final machine configuration should also be completed along with cost estimates. Assess the Technology Readiness Level (TRL)/Manufacturing Readiness Level (MRL) at the end of the Phase I base effort (and option, if applicable).

PHASE II: Detailed design, fabrication, and testing should be accomplished. Control algorithms should be optimized by tests on actual hardware. The optimization should include not only the control of the sensor for orientation but also, the use of redundant axes and location of probe with respect to rotational axis, taking into account part curvature to minimize inertial force. The result will be a functional working prototype and vehicle for future software/control revisions and testing. A fully functional prototype should be demonstrated and the TRL/MRL assessment updated. The final demonstration should be performed in a relative environment with the design incorporating basic commercial considerations such as safety and operator inputs.

PHASE III: The design and software should be fully functional and used for measurement of airfoils for axial compressors of propulsion systems (military and commercial) as well as for power turbines. Focus on certifying and qualifying the system for Navy use. Commercialize and transition the system to the Navy fleet, specifically the JSF platform. The measurement system will allow detailed post-manufacturing inspection in order to document manufacturing discrepancies and mitigate installation of flawed components within a reasonable duration.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The equipment developed will be useful for measurement of airfoils for axial compressors of propulsion systems (military and commercial) as well as power turbines. This is a substantial market on its own. In addition, the developed adaptive scanning will have potential benefit to any industry and application where coordinate metrology is used. Measurement times may be reduced for aerospace, automotive, optical, medical, electronics, semiconductor, etc. applications.

REFERENCES:
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3. DoD 5000.2-R, Appendix 6, pg. 204. Technology Readiness Levels and Their Definitions. http://www.acq.osd.mil/ie/bei/pm/ref-library/dodi/p50002r.pdf

4. Manufacturing Readiness Level (MRL) Deskbook, May 2011. http://www.dodmrl.com/MRL_Deskbook_V2.pdf

KEYWORDS: Inspection; Measurement; BLISK; IBR; MANUFACTURE; Compressor

TPOC: (301)757-0486
2nd TPOC: (301)757-0472

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N151-018 TITLE: Integrated Laser and Modulator

TECHNOLOGY AREAS: Air Platform, Sensors, Electronics

ACQUISITION PROGRAM: JSF-MS

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an integrated laser and intensity modulator for analog/radio frequency photonic links operating at 1.55 micron.

DESCRIPTION: Military communication systems on avionic platforms have very small size and low weight requirements. Fiber optic based links provide inherent advantages over electronic based systems due to ultra-wide bandwidth, immunity to electromagnetic interference and reduced weight. Despite the advantages provided by fiber optics, the size of an entire system is still limited by engineering tradeoffs such as the spacing required between components due to the fiber optic interfaces and the packaging size of individual components. Specifically, the required use of optical fiber between the laser and modulator limits the ability to create a compact transmit system. A standard system includes a laser, modulator and a photodiode receiver. Typically there is some active and/or passive signal processing that can be done post modulator, indicating that the laser and modulator are consecutive. Thus a small packaged integrated laser and modulator device is needed.

Recently low relative intensity noise (RIN) lasers and small form factor modulators have become commercially available. However, the challenges posed by integrating both components together in a very small form factor package without the aid of fiber has yet to be accomplished, as typically the laser and modulator are of differing materials. Some work has been done to integrate optical components monolithically [1, 2], and heterogeneously [3], but researchers have yet to demonstrate an integrated laser and modulator design at power levels needed for most radio frequency (RF)/analog photonic links.

RF/analog photonic links suffer from complexity and size since the components cannot be built on one chip. Avionic platforms, as well as radar applications, would benefit from a very compact integrated link. Integrated laser and intensity modulators operating at 1.55 micron are desired with a minimum linewidth requirement of less than (<) 200 kHz and ideally < 100 kHz, and relative intensity noise of < -169 dBc/Hz from DC to at least 20 GHz. The intensity modulator should have a 3 dB bandwidth of at least 20 GHz and ideally 40 GHz, with a radio frequency (RF) Vp < 3 V at 1 GHz, a reflection coefficient (S11) of < 15 dB and 25 mW output power when biased at quadrature. The extinction ratio is required to be > 20 dB but is desired to be > 25 dB. Typically, a laser and modulator interfaced via optical fiber are of different material types. The desired laser and modulator interface may be of the same or differing materials so long as the two are combined without the aid of optical fiber on a single chip, monolithically or heterogeneously. The integrated device should be designed such that dimensions in height and width are feasible for packaging at 1 cm by 1 cm with a length not to exceed 15 cm. Ideally, the dimensions should not exceed a packaging requirement of 5 mm by 5 mm by 10 cm for the integrated laser and modulator interface. The inputs should include a female K connector (2.92 mm) and bias control for the modulator, as well as laser bias and thermal electric cooler (TEC) control if necessary and a fiber output style ferrule connector (FC)/angled physical contact (APC) (FC/APC). Collaboration with an original equipment manufacturer (OEM) in all phases is encouraged, but not required, to assist in defining aircraft integration and commercialization requirements. TRL (Technology Readiness Level)/MRL (Manufacturing Readiness Level) assessments at the conclusion of each phase should be performed.

PHASE I: Design and analyze a new approach for an integrated laser and modulator device addressing the goals in the description. The approach to optical coupling or monolithic integration should be demonstrated in a bench top experiment as well as the electronic circuitry needed for RF and direct current (DC) bias and any temperature control if required. Perform modeling and simulation of the device and analyze required power handling and frequency requirements. Perform a proof-of-concept demonstration and a Technology Readiness Level (TRL)/Manufacturing Readiness Level (MRL) assessment.

PHASE II: Build, test and demonstrate a prototype heterogeneously integrated laser and modulator interface device with bench-top experiment showing 20 GHz bandwidth with 25 mW output power at quadrature and RF Vp of no more than 3 V at 1 GHz. Develop packaging suitable for transition to Navy aircraft applications and develop integration plan. Test prototype integrated laser and modulator in an RF photonic link with the objective performance levels reached. Characterize the packaged device over the full –40 to +100 degrees Celsius ambient temperature range. If necessary, perform root cause analysis and remediate packaged integrated laser and module failures. Deliver packaged laser prototypes on evaluation boards. Update TRL/MRL assessment.

PHASE III: Finalize packaging for transition to military and commercial applications. Develop plan and demonstrate capability to fabricate and package devices for military platforms and outline design for typical avionic ruggedness requirements. Perform final avionics integration activities and qualification testing. Demonstrate plan for device manufacturing.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The technology would find application in commercial systems such as fiber optic networks and telecommunications.

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KEYWORDS: Laser; Modulator; RF Photonics; Heterogeneous; Integrated; Packaging

TPOC: (301)342-9115
2nd TPOC: (301)342-9098

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N151-019 TITLE: Hardware Open Systems Technologies (HOST) Conformant Secure Network Server

TECHNOLOGY AREAS: Air Platform

ACQUISITION PROGRAM: PMA 209

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop, demonstrate, and validate a secure network server, based on the Hardware Open Systems Technologies (HOST) Standard, that can operate in a real time (or near real time) system while minimizing space, weight, power and cooling (SWaP-C).

DESCRIPTION: Today's military aviation community has many standards to choose from when developing hardware for government use. Two well recognized examples of these standards are VME and OpenVPX. While these standards provide a general basis from which to develop hardware, they contain enough flexibility that two vendors can build to this standard and produce a product whose components are not portable - meaning that a module from one vendor's product cannot be placed in another vendor's product with the expectation of full function. The Navy is currently maturing a standard, called HOST, whose purpose is to reduce the variability in existing standards (such as VME and OpenVPX) such that the portability of components within the computing architecture is enabled.

One common design challenge in open architecture systems is achieving the optimal trade between SWaP-C and latency. The purpose of an open architecture is to generalize hardware module interfaces to ensure that the interface can support hardware components from multiple independent vendors. This generalization may, in some cases, lead to an implementation that is not optimized with respect to latency. In avionics systems that are required to function in real time or near real time, any potential latency generated via an open architecture is a problem. A common way to fix the latency problem is to add additional processing capabilities. However, due to the additional weight and power requirements this solution requires, it is not a viable option for an aircraft implementation.

The Navy requires the development of a secure network server that can implement open architecture (i.e. built to the HOST standard). This device must be able to operate in real time (or near real time) without any latency generated from the open architecture design, and without any increase in SWaP-C requirements. This server must be capable of hosting traditionally developed software as well as software developed in accordance with the Future Airborne Capability Environment (FACE) Technical Standard. The server will be used as a surrogate to demonstrate component portability with an existing government HOST conformant computer, as well as to validate the design meets real time (or near real time) latency standards.

PHASE I: Design and develop a concept for a HOST conformant open architecture secure network server, that can demonstrate module portability with an existing government HOST conformant computer, as well as operate in a real time (or near real time) system while minimizing SWaP-C. Analyze the SWaP-C and latency expectations for this concept and compare with existing network server implementations (to be agreed upon at project start) to verify the HOST conformant design concept exceeds current non-HOST performance specifications.

PHASE II: Based upon the findings from Phase I, build the prototype secure network server and test the device by interfacing and demonstrating modular portability with a Government HOST conformant computer. In addition to demonstrating hardware portability, continue to optimize the critical trade space between SWaP-C and latency for avionics implementation.

PHASE III: Transition the prototype secure network server to a production representative network server that meets commercial and Navy avionics flight worthy requirements.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This innovation will significantly enhance the capability and flexibility of military and civilian aircraft while enabling additional safety and mission critical systems to be developed, integrated and fielded at a lower cost and reduced developmental cycles. As a system of systems, or distributed application, the HOST Standard will enable the combination of a variety of different system hardware architecture representations.

REFERENCES:

1. NAVAIR. (2014). Technical Standard for Future Airborne Capability Environment (FACE), Edition 2.1. Retrieved from https://www2.opengroup.org/ogsys/catalog/c145

2. RAND® Corporation. (2011). Finding Services for an Open Architecture. Retrieved from http://www.rand.org/pubs/monographs/MG1071.html

3. NAVAIR PMA-209. Hardware Open Systems Technology (HOST) Tier 1 standard. (Please visit SITIS to download)

4. NAVAIR PMA-209. Hardware Open Systems Technology (HOST) Tier 2 standard. (Please visit SITIS to download)

KEYWORDS: Interoperability; Avionics; Architecture; Mission Systems; FACE; HOST

TPOC:	301-757-6415
2nd TPOC:	(301)757-6145
3rd TPOC:	(301)995-4347

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N151-020 TITLE: Command and Control of Multiple Unmanned Air Vehicles in Anti-Access Area-Denial or Highly Limited Communication Bandwidth Environment

TECHNOLOGY AREAS: Air Platform, Information Systems, Electronics

ACQUISITION PROGRAM: PMA 281

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Design and develop software that provides the capability to autonomously and dynamically adapt to varying Anti-Access Area-Denial (A2AD) bandwidth-limited environments to ensure the transmission of critical information content for Command and Control (C2) decisions, as well as other mission critical data, in a multiple unmanned vehicle mission environment.

DESCRIPTION: Unmanned Aerial Vehicle (UAV) operations require bandwidth that can vary for a variety of reasons, including different mission phases, different geographic locations and attenuation of signals (both intentional and unintentional).

To maximize the use of finite resources for C2 and make the systems more resilient, a software-defined tool that monitors behavior and dynamically allocates bandwidth utilization to optimize critical messages in a multiple UAV mission environment is needed. The software tool should be designed to interface with program of record systems, like Automated Digital Network System (ADNS), that can handle the actual routing of digitized C2 information.

It is prudent before proceeding to examine current technology regarding this bandwidth-limited operational capability. Many technical references are available that focus on the A2AD bandwidth limitation topic, but a software tool in support of C2 for multiple UAV missions within A2AD or bandwidth limited environment does not currently exist. Current technology often builds upon basic concepts like quality of service and solutions are desired that provide more robustness, flexibility and higher performance.

Development should be focused on enabling applications to utilize existing and evolving standards, like Naval Interoperability Profile Standards (NIOPS), for both multiple unmanned vehicle control and mission management. The desired software tool should be able to automatically react to changes in bandwidth by both prioritizing and optimizing the data being transmitted within the operational context of the supported unmanned vehicles. The software should also automatically transmit previously established prioritized information in varying levels of bandwidth restricted environments. Methods could involve reduced frequency of transmission, reducing the type and/or fields of data transmitted, or other techniques that would allow the tool to react to the variability of the limitations and thus maximize available bandwidth.

Additionally, the tool should allow the operator the option to override the autonomous dynamic functionality and manually control settings related to throughput or rate of transmission. All user interfaces should be simple and intuitive to reduce operator workload.

The software tool is expected to be integrated into the Common Control System (CCS) which is developed and managed by PMA-281, a NAVAIR Program Office responsible for strike planning and mission execution systems.

Note that due to the distribution restriction, the NIOPS standards document, titled "Vehicle Management Advanced Command and Control (VM-ADV-C2) Navy Interoperability Profile (NIOP)", will be provided to companies awarded a Phase I contract.

PHASE I: Complete initial design and development activities to prove feasibility of a software tool capable of identifying bandwidth limitation and automatically adapting bandwidth allocation in order to transmit critical information for C2, as well as other mission critical information in support of operating multiple unmanned vehicles.

PHASE II: Develop a software prototype based on Phase I effort using conceptual techniques and demonstrate in a simulated bandwidth-limited environment.

PHASE III: Finalize, operationally test and transition the software tool as a functionality/application within the Unmanned Vehicles CCS.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This tool will be suitable for all commercial and government unmanned vehicle applications. Multiple government agencies, not limited to DoD, operate UAVs that can leverage this technology to enable more reliant and flexible communications. Commercial UAVs routinely operate in austere environments with limited bandwidth, or are subject to inadvertent degradation of signals, and will also find multiple applications of this specific technology.

REFERENCES:
1. Unmanned Systems Integrated Roadmap, FY2013-2038. Retrieved from http://www.defense.gov/pubs/DOD-USRM-2013.pdf

2. Howard, C. (2013). UAV Command, Control and Communication. Military and Aerospace Electronics, Volume 24(7). Retrieved from http://www.militaryaerospace.com/articles/print/volume-24/issue-7/special-report/uav-command-control-communications.html

3. Stansbury, R. S., Vyas, M. A., & Wilson, T. A. (2009). A Survey of UAS Technologies for Command, Control, and Communication (C3). Journal of Intelligent and Robotic Systems. Volume 54(1-3), 61-78

4. Code 31 Strategic Science and Technology Plan 2012. ONR C4ISR Department Publication. Retrieved from http://www.onr.navy.mil/en/Science-Technology/Departments/~/media/Files/31/Code-31-Strategic-Plan-2012.ashx

5. Navy Information Dominance Roadmap. Retrieved from http://www.defenseinnovationmarketplace.mil/resources/Information_Dominance_Roadmap_March_2013.pdf. Last accessed 03/18/2014.

KEYWORDS: Command And Control; Unmanned Vehicles; Anti-Access; Communication; Area-Denial; Bandwidth Limitation

TPOC: (301)757-3739
2nd TPOC: (301)757-6179

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N151-021 TITLE: Advanced Modeling and Visualization of Effects for Future Electronic Warfare Systems

TECHNOLOGY AREAS: Air Platform, Information Systems

ACQUISITION PROGRAM: PMA 234

OBJECTIVE: Develop the capability to model and visualize the complex tactical electronic warfare (EW) environment, including EW effects, threat radars, tactical aircraft, and other tactically-relevant information in support of Airborne Electronic Attack (AEA) mission planning for current and future EW systems, such as the Next Generation Jammer (NGJ).

DESCRIPTION: The Navy is interested in novel approaches for modeling and visualizing the complex tactical EW environment. Current capabilities provide a variety of complex threat, jammer, and environment models in addition to highly representative and useful visual approaches.

Currently, two-dimensional (2D), and some three-dimensional (3D), visualization environments are available for seeing EW effects within a tactically-relevant threat environment. These capabilities are already part of, or will soon be part of, the AEA Unique Planning Component (UPC) within the Joint Mission Planning System (JMPS) suite of software used for EW mission planning. Methods for expanding the current visualization approaches to support advanced EW capabilities for systems such as NGJ are needed. These advanced capabilities include electronically-steered antennas, advanced waveform generation, utilization of digital radio frequency memory (DRFM) and other advanced targeting approaches.

These visualizations should take into account human factors issues, such as screen clutter, density, and ease of use. In complex threat environments, it is easy for the operator to become confused from the large amount of information provided and the manner in which it is drawn and presented. As part of this effort, approaches for “de-cluttering” the display should also be identified to allow for useful, tactical employment of these capabilities. Measurements of operator workload and/or operator situational awareness should be used to demonstrate that these human factors issues have been effectively accounted for (References 1-3). Additional information will be provided by the TPOC to the Phase I awardees.

PHASE I: Develop and demonstrate the feasibility of a concept for models and visuals of the complex tactical EW environment that support the needs of current and future Navy EW capabilities. Prepare a development plan which addresses technical risk reduction and provides performance goals and key technical milestones, to be included in the Phase I Final Report.

PHASE II: Based on the results of Phase I, develop and demonstrate a prototype that models and visualizes the complex tactical EW environment. Demonstrate performance through evaluation of the prototype system within a wide range of operational scenarios and environments. Measurements of operator workload and/or operator situational awareness should be included in the performance evaluation (References 1 -3). Results of these demonstrations will be used to further refine and expand on the prototype solution set. Prepare a Phase III development plan to transition the technology.

PHASE III: Transition the system technology for operational testing and evaluation as an EW mission planning system for both Naval and commercial applications. Naval applications are the JMPS UPC's which employ AEA. Naval certifications and training material development will follow standards already defined for the applicable JMPS UPC's.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Derivatives of this simulation tool could be used by spectrum-regulating agencies, such as the Federal Communications Commission (FCC), to more effectively model interference possibilities among a great variety of competing radio frequency (RF) users. The tool could also be used by commercial industry to design RF systems with reduced interference among competing users.

REFERENCES:

1. NASA Task Load Index (TLX), Retrieved from http://humansystems.arc.nasa.gov/groups/tlx/tlxpublications.html

2. Donmez, B., Cummings, M., Graham, H., & Brzezinski, A. (2010). Modified Cooper Harper scales for assessing unmanned vehicle displays. Retrieved from http://hdl.handle.net/1721.1/81763

3. Endsley, M. R. (1988). Situation Awareness Global Assessment Technique (SAGAT). Northrop Aircraft, Hawthorne, CA. In proceeding of: Aerospace and Electronics Conference, 1988. NAECON 1988. Proceedings of the IEEE 1988 National. Retrieved from http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=195097&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxpls%2Fabs_all.jsp%3Farnumber%3D195097.

KEYWORDS: Visualization; Situation Awareness; Digital Radio Frequency Memory (Drfm); Radio Frequency (Rf); Electronic Warfare (EW); Next Generation Jammer (NGJ)

TPOC:	(301)342-0043
2nd TPOC:	(301)757-9314
3rd TPOC:	(301)757-7885

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N151-022 TITLE: <u>Method for Removal of Airfield Paint Markings and Aircraft Tire Rubber Build-up from Installed AM2 Mat Surfaces</u>

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: PMA 251

OBJECTIVE: Develop a minimally-invasive airfield paint marking and aircraft tire rubber build-up removal technology for installed AM2 mat surfaces.

DESCRIPTION: Expeditionary Airfields (EAFs) are shore-based aviation support systems that allow military aircraft to be rapidly launched and recovered ashore, independent of local facilities. From the most basic of EAFs, such as a grass landing zone for helicopter operations, to more complex solutions, such as large-scale airfield surfacing systems with airfield lighting and aircraft recovery systems, EAFs provide the means to safely and rapidly deploy and recover aircraft in a wide range of conditions. The major subsystems include Airfield Surfacing Systems, Airfield Lighting and Marking Systems and Aircraft Recovery Systems. These EAF sites are assembled using Airfield Surfacing Systems and AM2 mats in a building block concept. Sheets of AM2 mat are used to form runways, taxiways, parking areas and other areas required for efficient aircraft operations and maintenance. AM2 mats consist of 2-ft by 12-ft and 2-ft by 6-ft aluminum panels that are coated with an epoxy nonskid coating material. Each panel has four interlocking edges that permit easy assembly into rectangular expanses which may be theoretically endless in size and proportions. The AM2 mat was designed to withstand the high wheel-loading imposed by tactical aircraft, including arresting hook impacts and heavy transport aircraft.

A significant concern for the EAF Program is the removal of airfield paint markings and aircraft tire rubber build-up from installed AM2 mat surfaces. Airfield paint markings are employed at EAFs and painted onto AM2 mat surfaces. As airfield operations change or AM2 mats are moved to alternate locations, these airfield paint markings are required to be painted over in order to alleviate the potential for distracting presentations to pilots and ground crew. However, in some cases where airfield markings are painted over and invisible to the naked eye, they are still visible by the night vision devices used by all rotary pilots during night operations. The AM2 mat is coated with a nonskid material that provides an aggressive frictional profile for safe aircraft operations. After prolonged periods of aircraft operations, aircraft tire rubber accumulates on the AM2 mat resulting in a corresponding decrease in its frictional profile.

Currently, there is no procedure for removing airfield paint markings or accumulated tire rubber. If it is determined that an unacceptable amount of rubber has accumulated on a section of AM2 mat, that section of AM2 mat is simply removed and replaced.

An innovative method to remove unwanted airfield paint markings and aircraft tire rubber build-up from installed AM2 mat surfaces without creating a distracting reflective/contrasting image when viewed through night vision devices is needed. This process should have the ability to remove airfield paint markings and aircraft tire rubber build-up with no more than 10% effect on the integrity of the AM2 mat nonskid coating. This should be achievable with an easily maintainable, environmentally friendly, single operator device and should be done while installed on the airfield. This technology can be either mechanical or chemical, but must be of an expeditionary nature and not adversely impact local Environmental Protection Agency (EPA) requirements. The means of airfield paint marking and aircraft tire rubber build-up removal must also not react with the nonskid coating in a way that would degrade the AM2 mat surface friction profile more than 10%.

The type of paint currently used to mark the AM2 mat on an EAF conforms to FED-STD-595. The airfield marking paint comes in a variety of colors such as yellow or white and utilizes glass beads for reflectivity.

In order to effectively remove airfield paint markings and aircraft tire rubber build-up from AM2 mat surfaces, the material properties and structural specifications of the AM2 mat should be considered. AM2 mat is fabricated from 6061 Aluminum alloy, tempered to the T6 condition. The AM2 mat structure is composed of thirteen hollow cores with integral rib stiffeners. The top skin thickness is approximately 0.14 inches and the bottom skin thickness is approximately 0.125 inches. The AM2 mat is deployed in a few different sizes, mainly consisting of a 2-ft by 6-ft by 1.5-in panel and a 2-ft by 12-ft by 1.5-in panel. In addition, the AM2 mat is painted green and the top skin is coated with an epoxy-based nonskid material approximately 30-mil in thickness. An AM2 mat will be provided as Government Furnished Equipment (GFE) to all Phase I awardees.

EAFs can have airfield runway dimensions of 96 ft. wide by 4,000 ft. long or greater, justifying the need for a method that can cover large swaths of airfield quickly and easily. The technology shall be capable of removing airfield paint markings and aircraft tire rubber build-up from 6 to 20 in wide and up to 1 mile long with a single pass. AM2 mat is used in a wide variety of operational conditions ranging from arctic zones, temperate zones, tropical and subtropical zones, and semi-arid and arid zones, thus warranting the need for a method that can be easily and effectively transported and operated in a plethora of climatic conditions. The technology would not only aid in ensuring the safety of the Warfighter, equipment and aircraft, but it would also increase ease-of-use and provide cost reduction opportunities, as well as commercial applications. The ability to remove airfield paint markings and aircraft tire rubber build-up from AM2 mat surfaces would also enable preventive maintenance, allowing problems to be addressed before they escalate and result in costly, damaging effects.

PHASE I: Develop a conceptual design for an airfield paint marking and aircraft tire rubber build-up removal process that meets the requirements as stated in the description. Prove the feasibility of such a device through analysis and lab demonstrations.

PHASE II: Finalize, build, and demonstrate a prototype with the capability to remove airfield paint markings and aircraft tire rubber build-up from AM2 mat surfaces that would not significantly degrade the AM2 mat surface friction profile. Provide estimates for production cost.

PHASE III: Build production units for transition for EAF use. Provide logistics, including operational and maintenance manuals.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: In addition to benefits provided to the Department of Defense (DoD), the application of a technology that could safely remove airfield paint markings and aircraft tire rubber build-up from AM2 mat surfaces could provide the ability to safely remove these items from commercial airfield materials. By removing airfield paint markings and aircraft tire rubber build-up early on, maintenance work and preventive measures can be taken to ensure the safety of pilots and ground crew.

REFERENCES:
1. Pre-Engineered Structures: Short Airfield for Tactical Support. Retrieved from www.globalsecurity.org/military/library/policy/navy/nrtc/14251_ch11.pdf

2. Foster, D., & Anderson, M. (2003). Rapid Forward Deployment Made Easier with Composite Airfield Matting. The AMPTIAC Quarterly, 7, 1. 17-22.

KEYWORDS: Expeditionary Airfield (Eaf); Mat; method; AM2; Markings; Aircraft tire rubber build-up

TPOC:	(732)323-1386
2nd TPOC:	(732)323-1164
3rd TPOC:	(732)323-1064

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N151-023 TITLE: Low-Cost-By-Design Widely Tunable Mid-Wave Infrared Surface Emitting Lasers

TECHNOLOGY AREAS: Air Platform, Chemical/Bio Defense, Electronics

ACQUISITION PROGRAM: JSF-MS

OBJECTIVE: Develop a low-cost, robust, compact, widely tunable surface-emitting (SE) semiconductor laser with no mechanical moving parts of any kind. The device development in this program should enable significant performance improvement over the current incumbent mid-wave infrared (MWIR) semiconductor laser technology. More importantly, this program will enable game-changing wafer-level fabrication and testing for the MWIR tunable lasers to substantially reduce the cost of manufacturing by design and hence the affordability of the lasers.

DESCRIPTION: Quantum cascade lasers (QCLs) are being steadily incorporated into current and future Navy applications such as directional infrared countermeasure (DIRCM) and other surveillance mine and improvised explosive device sensing applications. In particular, the DIRCM performance could be substantially improved by the use of high-power widely tunable mid-wave infrared (MWIR) QCLs with excellent beam quality, which can defeat the future-generation missile infrared (IR) seeker head with laser-jamming wavelength-blocking countermeasures. However, serious performance and reliability gaps exist in commercially available external-cavity tuned QCLs [1, 2] that can prevent them from transitioning onto military platforms. These issues include high sensitivity to shock and vibration; high temperature variations of the precision optical alignment of all the external optical elements and mechanical moving parts; high manufacturing cost of the entire hybrid assembly of QCL and external optics; and, the inherently slow tuning speed due to required mechanical movement of grating for tuning. Current Navy research efforts are focusing on developing a completely monolithic, edge-emitting QCL solution with extremely wide wavelength tunability, high CW output power, and excellent beam quality

Monolithic SE MWIR QCLs hold promise for significant advantages over their edge-emitting counterparts in terms of both reliable operation and manufacturing cost. Recent reliability studies have shown that edge-emitting QCLs' failure modes are triggered by the QCLs' high facet optical-power densities and/or temperatures which, in turn, generally limit the reliable output power of edge-emitting QCLs. The Navy is also working on developing SE non-tunable QCLs to circumvent the reliability drawbacks of edge-emitting QCLs. More importantly, one of the Navy's goals is also to significantly improve the affordability of the MWIR QCLs. The cost reduction of the SE QCLs is primarily achieved via the elimination of a few high-cost, low-yield, labor intensive fabrication and packaging steps such as wafer lapping, cleaving, dicing, facet coatings, and chip bonding, etc., which amount to 60 to 75% of the total cost of manufacturing the edge-emitting QCLs.

The device developed as a result of this SBIR should enable significant performance improvement over the current incumbent MWIR semiconductor laser technology. More importantly, successful technology development will enable game-changing wafer-level fabrication and testing for the MWIR tunable lasers to substantially reduce the cost of manufacturing by design and hence the affordability of the lasers.

Each of the above-mentioned Navy efforts is on track to deliver each of its performance, affordability, and reliability objectives. Because of the unique affordability advantage of the SE QCLs and the performance and reliability benefits of the monolithic tunable QCLs, it is the goal of this SBIR to combine the best of both technologies to develop a low-cost-by-design, widely tunable MWIR SE QCL with unique, unparalleled combination of unprecedented high affordability, performance, and reliability.

PHASE I: Develop and prove feasibility of a viable, robust, and manufacturable design for a single widely tunable SE QCL with a room-temperature CW output power > 1 W over the entire tunable range at least ±12% from a center wavelength around ~4.6 micron with near diffraction-limited beam quality (M2 < 1.5). A viable design path forward for further increasing the output power of the SE tunable laser operating at CW mode at room temperature scheme should be proposed and included as part of the deliverable for Phase I.

PHASE II: Fabricate, demonstrate, and deliver a prototype of widely tunable SE QCL with output emission out of a single aperture with output power > 5 W CW and outstanding beam quality (M2 < 1.5) over the entire tunable range at least ±12% from a center wavelength around ~4.6 micron. Further demonstrate a viable path forward to power-scale the tunable SE QCL monolithically at the wafer level without external optics to power levels exceeding 20 W CW while maintaining M2 < 1.5. It is critical to incorporate manufacturing cost reduction as part of the design criteria throughout all the design phases in all phases of this program.

PHASE III: Fully develop and transition the widely tunable SE QCL for Department of Defense (DoD) application in the areas of DIRCM, advanced chemical sensors, LIDAR, and commercial applications.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The commercial sector can significantly benefit from this technology development in the areas of detection of toxic industrial gases, environmental monitoring, and non-invasive medical health monitoring and sensing.

REFERENCES:
1. Caffey, D., et al. (2011). Recent results from broadly tunable external cavity quantum cascade lasers. Presentation 7953-54. Paper presented at the International Society for Optics and Photonics, Photonics West 2011, San Francisco, California. doi: 10.1117/12.875093

2. Hugi, A., et al. (2009). External cavity quantum cascade laser tunable from 7.6 to 11.4 um. Appl. Phys. Lett., 95, 61103.

KEYWORDS: Sensing; Qcl; Tunable; High Power; DIRCM; surface emitting

TPOC: (760)939-0239
2nd TPOC: (760)939-8940

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N151-024 TITLE: <u>Next Generation In-Situ Antenna Analysis and Design Toolbox</u>

TECHNOLOGY AREAS: Sensors, Battlespace

ACQUISITION PROGRAM: PMA 275

OBJECTIVE: Develop an innovative, exact-physics (EP), fast, high-order-accurate computational electromagnetics (CEM) capability that, in present-day computer clusters, can accurately simulate in-situ antenna performance on platforms of electrical length of the order of 500 to 1000 wavelengths and beyond.

DESCRIPTION: Measurement-based approaches to in-situ antenna characterization, while highly valuable for validation purposes, are unrealistically slow and very expensive in the design stage. Advances in CEM and computer technology are allowing us to gradually replace measurements in the design stage with electromagnetic (EM) modeling and simulation (M&S). In the frequency domain (FD), the domain of interest in this solicitation, there exist commercial-strength EM M&S codes, both EP and high-frequency (HF) ones, that do a commendable job. Those based on HF methods are limited in the accuracy they can provide while the ones based on EP can provide accuracy but cannot handle electrically large platforms principally because of the very large and dense systems of linear equations they generate. Even using today's CPU/GPU clusters, EP codes cannot handle a large platform without substantial cost in hardware and execution time. For this reason, the past decade has seen an intense research effort in overcoming these shortcomings [refs. 1 – 4]. Research results indicate that advances in CEM may enable accurate EP simulation of vitally important, electrically large radiation problems arising from aircraft-mounted antenna systems, and, therefore, may provide an enabling alternative to measurement, and a significantly more accurate substitute for methods based on HF approximations.

A FD, EP, boundary-integral-equation EM M&S software capability is sought. It should be able to read a CAD file of a structure with a large number (> 10) of antennas mounted on it, and have the ability to effectively evaluate the electromagnetic fields in prescribed regions of space, taking into account the structure's geometry and material properties (as well as those of the antennas).

The computational engine should provide high-order accuracy and an order-of-magnitude acceleration over current solvers (high-order accuracy occurs when the reductions in the solution error that result from a given reduction in the mesh-size h amount to a "high" power p of the mesh-size reduction factor). The goal is to be able to handle a 1,000-wavelength-long platform in a moderate size CPU/GPU cluster at a tenth of the current computational cost of a commercial, accelerated, moment method code that uses RWG functions [ref. 5]. (As an example, the current NAVAIR 4.5.5 GPU cluster comprises a master node and ten compute nodes. Each compute node has 1 Intel E5620 Dual Processor Quad Core, 48 GB RAM, 2 TB HDD, and 4 NVIDIA Tesla M2070 6 GB modules. The master node has 1 Intel E5620 Dual Processor Quad Core, 24 GB RAM, and 500 GB HDD). A well designed Graphical User Interface (GUI) should be made available for easy access to the software capabilities. The proposer should demonstrate, in the proposal, ownership of all existing and to-be-developed source code or an appropriate arrangement with a subcontractor.

PHASE I: Demonstrate the feasibility, on the basis of CAD descriptions of aircraft and antennas, of a solution for 1,000-wavelength radiation problems with high order accuracy in present day distributed memory computer clusters.

PHASE II: Refine the methodology developed during Phase I to demonstrate the solution for a very large platform (1000 wavelengths in size) with at least ten antennas on it. The antenna-platform system will comprise both perfect conductors and dielectric materials. Develop a user friendly GUI with good pre- and post-processing capability.

PHASE III: Refine the tools developed during Phase II and develop a commercial-grade software tool that provides an end-to-end modeling capability for Navy and civilian application areas. Refine GUI and provide thorough user documentation. Fully implement hardware acceleration on latest technology computer clusters.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Antenna in-situ performance and co-site interference are problems common to both military and commercial aircraft. This tool will find equal use in commercial avionics as in military ones.

REFERENCES:
1. Jørgensen, E., Volakis, J.L., Meincke P. & O. Breinbjerg, (2004). Higher Order Hierarchical Legendre Basis Functions for Electromagnetic Modeling, IEEE Trans Antennas Propagat, Vol. 52, No. 11, pp. 2985-2995.

2. Notaroš, B.M. (2008). Higher Order Frequency-Domain Computational Electromagnetics, IEEE Trans Antennas Propagat, Vol. 56, No. 8, pp. 2251-2276.

3. Bruno, O., Elling, T., Paffenroth, R. & Turc, C. (2009). Electromagnetic integral equations requiring a small number of Krylov-subspace iterations, J. Comp. Phys., Vol. 228, pp. 6169-6183.

4. Kaufmann, T. (2011). The Meshless Radial Point Interpolation Method for Electromagnetics. Doctor of Sciences thesis, ETH Zurich.

5. Rao, S. M., Wilton, D. R. & Glisson, A. W. (1982). Electromagnetic scattering by surfaces of arbitrary shape, IEEE Trans. Antennas Propag.,vol. AP-30, no. 3, pp. 409–418.

KEYWORDS: Computational Electromagnetics; Cpu/Gpu Clusters; exact physics methods; in-situ antenna analysis; high-order accurate; GUI design

TPOC: (631)673-8176
2nd TPOC: (301)342-2637

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N151-025 TITLE: Ignition Composition with Low Moisture Susceptibility

TECHNOLOGY AREAS: Air Platform, Materials/Processes, Weapons

ACQUISITION PROGRAM: PMA 272

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an ignition composition that is not susceptible to moisture, is stable with respect to long term storage, is easy to light, provides excellent ignition transfer, is easy to fabricate, and is safe to handle.

DESCRIPTION: Many Airborne Expendable Infrared Countermeasures (AEIRCMs) utilized by the U.S. Navy exploit a sympathetically ignited spring-loaded bore-sensing Safe-and-Arm (S&A) type igniter assembly. The S&A is lit by an impulse cartridge during dispense of the countermeasure. The S&A limits the ignition of the primary pyrotechnic payload until it exits the flare cartridge or is outside of the aircraft. As a result, the performance and reliability of the AEIRCM is related to (1) quickly lighting the ignition pellet within the S&A type igniter from the impulse cartridge while exiting the flare cartridge and (2) quickly lighting the primary pyrotechnic payload from the S&A's ignition pellet upon exiting the flare cartridge or the aircraft.

The ignition pellet within the S&A type igniter currently consists of a composition based on Magnesium/Teflon®/Viton® (MTV). Magnesium is known to degrade when exposed to moisture, which in return can increase ignition times and, in more extreme cases, can result in non-ignitions. Another consequence of this degradation is the evolution of hydrogen gas, which poses an ignition hazard.

Identify, develop and demonstrate a replacement for the current MTV based ignition pellet in the S&A type igniter. The replacement should not be susceptible to moisture degradation, should be stable in long term storage, should be reliably ignitable by an impulse cartridge, should provide rapid ignition transfer to the primary pyrotechnic, should be simple to fabricate, and should be safe to handle and process. The operational conditions in which this ignition pellet will be evaluated range from -65 degrees F to 160 degrees F.

Proposers should be able to obtain, mix and process the raw ingredients for any proposed replacement or energetic composition (Hazard Class 1.3 or 1.1).

PHASE I: Develop suitable ignition compositions. Characterize ignition compositions with respect to safety (friction, static, impact, ignition temperature), aging, and ignitability. The most promising candidates should be pressed in S&A hardware for government evaluation for ignitability by impulse cartridge. The press tooling and S&A hardware will be provided as government furnished equipment and material if needed.

PHASE II: Fabricate and deliver S&A type igniter assembly prototype(s) for government evaluation using various pyrotechnic payloads and compare against the MTV S&A type igniter in static and flight function tests.

PHASE III: Transition a full-scale manufacturing process for proposed ignition composition material to the U.S. Navy. Lead in the manufacturing and testing efforts required to qualify the new composition for U.S. Navy use, as well as pursue potential commercial uses.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Various energetic mixes developed for potential commercial uses in such things as air bags, rocket motors, primers, small arms, etc. are potential commercial uses for a successful development effort.

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KEYWORDS: Countermeasures; Moisture; Ignition; Flare; Magnesium; Pyrotechnic

TPOC: (812)854-6631
2nd TPOC: (812)854-6136

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N151-026 TITLE: Small Non-Cooperative Collision Avoidance Systems Suited to Small Tactical Unmanned Systems

TECHNOLOGY AREAS: Sensors, Electronics

ACQUISITION PROGRAM: PMA 263

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a non-cooperative compact collision avoidance system with Space, Weight, and Power (SWaP) characteristics suited for small tactical Group 2/3 unmanned aerial system (UAS).

DESCRIPTION: New Federal Aviation Administration (FAA) rules for Next Generation (NextGen) national airspace surveillance strategy, which are set to be implemented by 2020, will strengthen the requirements for most aircraft, in most airspace, to determine their position via satellite navigation and periodically broadcast it out for receipt by air traffic control ground stations as well as other aircraft. Aircraft will be required to have at least one of the Automatic Dependent Surveillance-Broadcast (ADS-B) “out” standards, either 1090 or 978 megahertz (MHz), to broadcast their position and velocity data. The data is broadcast every second, providing real-time position information that will, in most cases, be more accurate than the information provided by the primary and secondary radar based systems that are currently in use. Aircraft to aircraft ADS-B transmission will also permit highly reliable self-separation and collision avoidance for any aircraft outfitted with dual frequency ADS-B “in”, enabling the aircraft to avoid other aircraft that are “co-operating” in the environment. However, there will remain in all airspace, aircraft that are not transmitting ADS-B “out”. These may be aircraft that either do not have a transmitter, or that have a transmitter that is turned off or has failed. These non-cooperating aircraft will continue to pose a collision hazard for UAS.

A collision avoidance system that does not rely solely on co-operating aircraft that are ADS-B equipped is needed to ensure safe integration of UAS into the airspace. This system should ideally utilize ADS-B and in all aspects provide information for pilot oversight, self-separation and collision avoidance. It should additionally provide a fully autonomous self-separation and collision avoidance capability as an option of last resort.

Non-cooperative approaches have included visible and infrared (IR) camera systems, acoustic systems, radar systems and other radio frequency (RF) distance measuring technologies. The advent of Software Definable Radios (SDR) could potentially lead to an effective RF non-cooperative collision avoidance system with a small SWaP suitable for use with even small UAS.

The solution will be required to fit on a Group 2/3 UAS (such as the Aerosonde, Scan Eagle, RQ-21A Blackjack, or RQ-7B Shadow air vehicles and systems). An additional project goal would be compatibility with smaller Group 1 Small Unit Remote Scouting Systems (SURSS) such as the RQ-20A Puma, RQ-11B Raven, and RQ-12A Wasp family of systems. For a non-cooperative collision avoidance system to be accepted as a component technology of a Group 2 or Group 3 UAS, the SWaP consumption is a critical parameter. To be compatible with Small Tactical UAS (STUAS), the solution needs to have a small SWaP allowing for mission payloads and a low cost for baseline UAS system incorporation. Given the payload capacity of Scan Eagle (a Group 2 UAS) is on the order of 7.5 pounds at 60 watts, it is expected the SWaP for a non-cooperative collision avoidance system be a fraction of this capacity. All airborne hardware should weigh less than 12 ounces and consume less than 27 cubic inches of total space, with a power draw of less than 25 watts average. The collision avoidance system hardware can be distributed to various locations on the air vehicle but cannot significantly affect weight and balance or aerodynamic performance. A range of 2 to 5 miles for small RF cross section targets is needed. All UAS flyable weather performance is desired,

Successful laboratory demonstration by simulation of software-in-the-loop (SIL) and/ or hardware-in-the-loop (HIL) would be the first step towards a successful product. Desired next level testing would include air demonstrations in a restricted airspace environment, ideally in conjunction with a fully instrumented test range. These range demonstrations would be used to document the “mission readiness” and expected “mission effectiveness” of the system prior to testing in operational environments. Good results from restricted range testing would provide the leverage to help with the safety case for the use of UAS for emergency course of action (COA) response. The results would also be applicable for improvements in the integrated UAS mission capability for all military applications.

PHASE I: Demonstrate the feasibility of an all-weather non-cooperative collision avoidance system through modeling and simulation demonstrations. Candidate tasks are (1) comprehensive modeling of the system approach; (2) demonstration of the key performance parameters (KPP) that will define detection performance; (3) performance evaluations of the design in terms of target detection and localization capabilities; (4) identification of performance limitations and hardware requirements to prepare for Phase II hardware implementation. Determine preliminary hardware design for Phase II effort.

PHASE II: Develop a prototype, non-cooperative collision avoidance system suitable for testing on manned or unmanned platforms. Implement the hardware design initiated in Phase I using commercial-of-the-self (COTS) components where possible. Fully investigate the performance and capability of the demonstration system. Plan for a flight demonstration of the system on either manned surrogate UAS or military UAS platform, if available. It is expected that the UAS or military UAS platform, will be provided as Government Furnished Equipment (GFE) or range support. Sense and Avoid (SAA) data should be collected and analyzed to determine the effectiveness of the system under realistic operating conditions. This SAA data should be delivered in a form that can be used to help justify the safety case of using UAS for various mission scenarios.

PHASE III: Further refine the collision avoidance system design to improve performance robustness for practical operation scenarios. Further miniaturization and low cost manufacturability of the capability may be required. Transition to military and commercial applications.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Commercial applications include potential use for both commercial UAS and commercial and private small aircraft. Initially the capability can be used to provide added safety in the use of UAS for first responders in a variety of civil applications. These include firefighting, crowd monitoring, damage assessment, search and rescue, and other emergencies where UAS would enhance the mission effectiveness.

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KEYWORDS: Collision Avoidance; ADS-B; Small Tactical UAS; Non-cooperative; self separation; autonomous operation

TPOC: (301)342-2025
2nd TPOC: (301)342-0923

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N151-027 TITLE: Condition Based Monitoring Computational Processes

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PMS 450, VIRGINIA Class Program Office.

OBJECTIVE: The objective is to develop computational processes that employ both deterministic and stochastic processes for correlating known transient functions with operational values to access an accurate state of conditions for monitoring health and predicting life-cycle.

DESCRIPTION: The US Navy has a current need for in situ non-destructive sensing and condition monitoring at the node for component system characteristics in the time, frequency or modal domains. A cost effective method for monitoring health is having an early warning system for machine failure. Algorithm based detection systems suited for machinery failure modes beginning at high frequencies can be triggered as a result of operational transients. To enhance prediction of failure modes, algorithms for tracking damage accumulation with continuous monitoring from acceleration disturbances provide essential information for helping to improve component design and scheduling of maintenance functions. Limitations on hardware storage and power efficiency sometimes prevent health monitoring sampling rates to be consistent and enabling high bandwidth transient capture is problematic given the available technology. Many approaches trending towards the use of statistical methods is highly recommended to solve missing data issues where gap filling is needed when predictive analysis is necessary for measuring the conditions at the node. Detection is necessary in situations where there are machine failures in real situation such as unexpected resonance conditions or deviations caused by operator error, improper maintenance or unexpected events. To aid in the detection of health monitoring, wireless sensors are required at the node or at the component level to capture transient or steady-state response. This is particularly important as a transfer function is necessary to establish a frame of reference from which to capture pattern recognition characteristics of the component. To this end data from sensors can be measured by a handful of instruments including accelerometer, strain gage, thermo, temperature, etc., and converted for analysis purposes from time to frequency domain using Fast-Fourier-Transform (FFT) techniques or to modal domain [1, 2, 3, 7, 8]. Diagnostic functions reduce troubleshooting and maintenance times, prevent fault misdiagnosis, and avoid incorrect part repair or unnecessary replacement. Wireless devices are packaged to allow installation or mounting to components with the intent of eliminating cabling runs and the maintenance and installation costs associated with cables [4, 6].

PHASE I: The company will develop logical processes necessary to write algorithms to digital signal process sensor data including transient and steady-state input for the purpose of identifying and predicting faults and failures. Use of statistical methods is paramount for successful health monitoring and trending analysis for maintenance actions and predictive failures. Input sensor and transient data shall be from similar shipboard component, reasonable likeness or modeled to simulate system functions including known and predictive failure modes. Components shall be shipboard systems requiring health monitoring such as, but not limited to, actuation of valves that operate by electric or hydraulic based linear and rotatory dynamics, pumps, motors, compressors, etc. Consideration for algorithm processing shall execute code on processors that will be designed to capture data at the node where the component resides for the purposes of allowing wireless hardware to transmit secure output. Algorithms will also need to track the damage accumulation with continuous acceleration data (and gap filling for missing data). Example cases of machine failure modes in real situations (especially off-design conditions that commonly lead to failures, such as unexpected resonance conditions or deviations caused by human error, improper maintenance or unexpected process conditions). The company will develop methods for collecting and processing data and define requirements necessary to apply to specific applications where diagnostics and prognostics can be performed to apply condition based monitoring techniques. The Navy needs will be meet as company demonstrates component systems are tested to validate successful detection from monitoring various intentional input failure modes and providing symptom/effect as a result of the fault and failure for trending and life-cycle predictions. The company will prepare a development plan for Phase II, which will address technical risk reduction associated with developing algorithms for condition based monitoring based on sensor, transient and steady-state data, as well as performance goals of detecting and validating failure modes and key algorithm and statistical development milestones.

PHASE II: Based on the results of Phase I and the Phase II development plan, the small business will be implementing the algorithms developed in Phase I within a comprehensive wireless infrastructure. The wireless infrastructure includes array of sensors common to a component node, wireless interface and self-contained power transmit and receive. The infrastructure is considered a managed network for a condition monitoring system. The company will follow a system development methodology already in progress that includes a requirements definition wherein performance, interface, security and reliability requirements are defined within a system specification. Component and software requirements specifications are developed based on the system requirements. The company will incorporate the algorithms for data processing into the infrastructure to add the diagnostics and prognostics necessary to allow for condition based monitoring at the node compatible within the wireless network. The entire infrastructure is considered a prototype and as such the company shall demonstrate that the algorithm will execute successfully and process various sensor input data defined within the system requirements and detect transient and steady-state waveforms for digital signal processing. It will be necessary to process data in the time, frequency and modal domain and allow for conversion from time domain to frequency domain using Fourier transform techniques. It will be necessary to demonstrate ability for correlation techniques of processing input data of a transfer function from operation to a known transfer function or criteria as reference. The differential will be used for deterministic as well as stochastic approach to measuring component health. Similarity sensor data will be auto-correlated to determine the solution for health status leading to actionable information. The successful system will be performance tested in situ either in a shipboard environment or laboratory depending on resources available. The testing will evaluate the analytical or model of simulated failure modes and data from actual component over a range of operational parameters to represent deployment cycles. Evaluation results will be used to refine the algorithms as necessary to meet Navy requirements. The company will prepare a Phase III development plan to transition the algorithms for Navy use.

PHASE III: If the Phase II is successful, the company will be expected to support the Navy in transitioning the algorithms for Navy use should a Phase III award occur. Based on the Phase II results, the company will integrate the algorithms into a next generation wireless infrastructure for installation on a ship to conduct testing as an effective tool for diagnostics and prognostics as part of a new era in shipboard wireless processing of sensor data for machinery condition based monitoring. The processes used for the algorithm will be defined and incorporated into the wireless infrastructure requirements specification and used for procurement purposes. The company will continue to support the Navy for revision to the algorithm to improve processes necessary to monitor various systems and variants as improvements are made to enhance at node machinery condition based monitoring techniques.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The technology developed under this topic could be used in a wide range of industry applications, providing specific system performance information, and a method for collecting and analyzing such information, to enable a breakthrough in wireless at node condition based monitoring for shipboard environment.

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KEYWORDS: Electric, hydraulic, actuator, wireless condition based monitoring; sensor, nodes, algorithm, diagnostics, prognostics, transient functions, damage accumulation, health monitoring, failure modes, detection and life-cycle

TPOC: Sherwood Polter
Phone: (215)897-8358
Email: sherwood.polter@navy.mil
2nd TPOC: Joe Budd
Phone: (215)897-8471
Email: joseph.budd@navy.mil

N151-028 TITLE: Coastal Battlefield Reconnaissance and Analysis (COBRA) Comprehensive Model for Scene Generation, Target Injection and Sensor Performance

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PMS495, Mine Warfare Program Office, COBRA

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Research and develop a comprehensive software scene generation, target injection and sensor performance model for COBRA.

DESCRIPTION: The COBRA program (Ref 1) is interested in technologies that facilitate automated target recognition capabilities for previously unseen environments and target threats. Typically, algorithms are based on available test data sets. This may hinder the assessment and optimization of system performance in new environments and for new target threats. Such constraints may lead to outliers in the operational performance of the system when generalizations of past performance are extended to specific unseen locales and target types. To address these issues, in lieu of conducting numerous costly data collections, there is a need for a comprehensive system model that can be used to generate images simulating those that might be acquired in new environments and/or with new target types. The technologies developed under this topic will decrease costs by lowering the number of flight tests necessary for algorithm development and enable performance estimations in areas of interest where imagery is lacking.

The comprehensive model to be developed will include sub-models for background terrain, targets, platform, and sensor. For potential techniques applicable to the comprehensive model, see Refs 2-5. Background terrain models can be cued from existing information sources, such as imagery collected by other airborne sensors. Target models will allow insertion of targets into the scene, including landmines and obstacles. The platform model will include aspects of the sensor platform affecting image acquisition, including platform position, orientation, and sensor pointing. A sensor model will provide a parametric, multi-spectral radiometric response given the scene radiometry generated by the other models. Imagery, metadata, and a data description will be provided to the selected contractor(s) by the Navy.

PHASE I: Develop a comprehensive model architecture for the COBRA image acquisition system. Prepare conceptual designs for each model component, including targets, scene background, platform and sensor. Develop the models so they are capable of inserting targets into existing COBRA images and demonstrate the feasibility of the approach on sample images. The company will provide a Phase II development plan that addresses technical risk reduction and provides performance goals and key technical milestones.

PHASE II: Based on Phase I designs and Phase II plan, implement complete scene generation and radiometric sensor models for COBRA. The scene generation model and radiometric models will be evaluated in conjunction with COBRA imagery previously collected to determine whether it can meet the performance goals defined in the Phase II development plan. Model performance will be demonstrated through prototype evaluation and detailed analysis. The company will prepare a Phase III development plan to transition the technology to Navy use.

PHASE III: If the Phase II is successful, the company will be expected to support the Navy in transitioning the technology for Navy use. The company will utilize the models and software tools to improve performance of the COBRA Block I and II systems. The company will also, support updates to the COBRA Technical Data Package (TDP) to support the Navy in transitioning the design and technology into the COBRA Production baseline for future Navy use. The company will support the Navy for test and validation to certify and qualify the system for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: In addition to application of the Comprehensive Model in the COBRA program, the technology is directly adaptable to many commercial activities that require performance evaluation of multi-spectral remote sensing systems for applications such as forestry, agriculture, and Intelligence Preparation of the Operational Environment (IPOE).

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KEYWORDS: Target insertion; multispectral scene generation; radiometric sensor model; Coastal Battlefield Reconnaissance and Analysis; passive multispectral; minefield detection

TPOC:	Andrew Blair
Phone:	(850)234-4474
Email:	andrew.blair@navy.mil
2nd TPOC:	Dawn Klamser
Phone:	(850)230-7148
Email:	Dawn.Klamser@navy.mil

N151-029 TITLE: Advanced Radio Magnetic Powder for Additive Manufacturing

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: PEO IWS2, PM SEWIP

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: To develop an additive manufacturing process for low loss, high index, and high wave characteristic impedance magnetic powder utilizing breakthrough technology to improve Navy Electronic Warfare (EW) systems.

DESCRIPTION: The Navy has a need to protect antennas from weather elements while seeking performance gains with advanced radome designs. Additively manufactured low loss, high index, and high characteristic impedance magnetic powders into shipboard materials could enhance the electromagnetic capabilities of these systems. The use of additive manufactured magnetic powders improves the structure materials' protecting antenna while enhancing the antenna capabilities through possible three-dimensional electromagnetic properties.

Recent advances in additive manufacturing have provided the enabling technology required to integrate these powder designs for the radome structures into the antenna systems. The Navy is seeking a process to introduce magnetic powders with particular electromagnetic characteristics that are not commercially available, described below, which can be additively manufactured in 2 ½ or 3 dimensional designs.

A successful powder shall leverage additive manufacturing procedures used by industry and the Navy (Ref 1). The ideal solution would be applicable to many naval applications and across a large frequency range. The combination of a high wave impedance magnetic powder and low wave impedance of the host medium should yield near free space impedance. The company will assist the Navy in transitioning in radomes with dielectric or magnetic powders inserted via additive manufacturing to increase antenna power for Navy use.

The concept for an additively manufactured material should operate in the 10-1000 megahertz (MHz) range with a band maximum electric and magnetic loss factor of 0.05, a band minimum index of refraction of 5, and near free space wave impedance at an operating range (5-10%). The effective properties of the magnetic powder and host medium can be modeled using effective media formulas (Ref 2). All approved materials will need to meet Navy Shipboard requirements for fire, smoke, and toxicity (Ref 3).

PHASE I: Develop a formulation and manufacturing process for magnetic powder that meets the requirements described in the topic description. Demonstrate the capability to produce a new radome design utilizing magnetic powders in an additive manufacturing process to increase performance as well as the feasibility to utilize dielectric powders in lieu of magnetic powders to meet evolving Navy needs.

PHASE II: Based on the results of Phase I and the Phase II contract statement of work, develop a 2½ or 3 dimensional varying prototype for evaluation that meets the description requirements. The prototype will be evaluated to determine its capability to meet future Navy needs for advanced radome powders. The prototype will be refined by the characterization of samples with homogeneous electromagnetic properties. Transmission line or free space measurement results of these homogeneous samples will be used to refine the prototype into an initial design that will meet Navy requirements with accompanying cost benefit analysis. The company will prepare a Phase III development plan to transition the technology for Navy use.

PHASE III: Support the Navy in transitioning in radomes with dielectric or magnetic powders inserted via additive manufacturing to increase antenna power for Navy use. Support the Navy for test and validation to certify and qualify the system for Navy use and transition to intended PEO IWS2.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The potential for commercial applications include miniaturization of antennas. This system will reduce the footprint of many antennas used for industry and other Department of Defense (DOD) applications. The use of additive manufactured magnetic powders improves the structure materials protecting antenna while enhancing the antenna capabilities though possible three dimensional electromagnetic properties.

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KEYWORDS: Impedance magnetic powders, additive manufacturing, antenna miniaturization, 3D electromagnetics, advanced radome designs, electronic warfare systems

TPOC: Michael Lutkenhouse
Phone: (301)227-8848
Email: michael.lutkenhouse@navy.mil
2nd TPOC: Brandon Good
Phone: (301)227-5489
Email: brandon.good@navy.mil

N151-030 TITLE: Automated Acoustic Monitoring System

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PEO IWS 5, Undersea Warfare Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an automated acoustic monitoring system to evaluate sensor performance and platform noise with the objective of improving overall combat system performance.

DESCRIPTION: The U.S. Navy needs an improved automated acoustic monitoring system on surface ship combatants to better alert operators to degraded sensor performance and to monitor platform noise. The Navy combat system employs many underwater acoustic sensors and processing [ref 1] designed to detect threat vessels. The performance of these sensors must be maintained at a high level for the combat system to perform effectively. Many of the sensors are exposed to harsh environments and operating conditions that compromise performance. In addition, excessive radiated noise emitted from the platform may limit the performance of one or more of these sensors. The fleet operators must be made aware of these degradations as soon as possible so they can take corrective action. These actions may require the operator to run diagnostic procedures, modify a sensor processing configuration, rely more heavily on other sensors, and issue a casualty report (CASREP) when the problem is severe.

The Navy system currently provides Performance Monitoring Fault Localization (PMFL) processed data for many of its acoustic sensors; however, in some cases it is not always clear to the operator what action should be taken. Condition Based Maintenance (CBM) has been successful at monitoring the status of equipment to facilitate efficient maintenance and lower the total cost of ownership. Although CBM more commonly uses sensors to facilitate the maintenance of inboard equipment, related techniques could be used for the maintenance of acoustic sensors themselves. An innovative automated system is desired that will process acoustic PMFL data and assist the operator in assessing overall sensor status and recommend corrective actions. Additional PMFL processing techniques that help detect telemetry processing issues, electronic noise and other intermittent issues are needed. Proposed algorithms should be able to distinguish between a processing induced artifact and real acoustic signal/transient in the water. The acoustic monitoring system will make recommendations to the operator to maximize overall acoustic performance while considering operational constraints and fault-tolerance of the current system software [ref 2]. For example, failed sensors can increase conventional beamformer (CBF) sidelobes. If too many sensors fail, CBF performance becomes compromised and array repairs are generally required. However, if the system uses adaptive beamforming [ref 3] that is more tolerant to failed sensors, perhaps array repairs can be deferred to a more convenient time. This example shows how PMFL action recommendations should consider the robustness of the system software that is running.

Array self-noise measurements will provide additional sensor health insight as well as help gauge expected/maximum sensor performance. Improvements are sought for the array self-noise surveys to better automate how the data is recorded, disseminated, and evaluated in support of regular maintenance activities. Approaches that account for operational and environment conditions such as ship speed, sea-state, and shipping traffic are encouraged. The sensor monitoring system is required to be fully integrated with the entire processing system. Innovative ideas are sought in the following areas: signal processing; sensor performance measurement; sensor acoustic performance prediction; and automated processing which result in improved operator awareness of sensor degradation and corrective action. Technologies developed under this topic may run standalone or will transition appropriately into existing software baselines such as the Sensor Performance Prediction Functional Segment (SPPFS) [ref 4].

PHASE I: The company will develop a concept for an automated acoustic monitoring system that meets the requirements described above. The company will demonstrate the feasibility of the concept in meeting Navy needs and will establish that the concept can be feasibly developed into a useful product for integration into existing combat system elements such as SQQ-89, BQQ-10 and/or UQQ-2. Testing and analytical modeling will establish feasibility.

PHASE II: Based on the results of Phase I, the company will develop a prototype of the Automated Acoustic Monitoring System for evaluation. The Prototype is primarily software but includes the additional benefit of a hardware component if applicable. The prototype will be evaluated to determine its capability in meeting performance goals and Navy requirements for the automated acoustic monitoring system. System performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters such as speeds, array configurations, sonar set up configurations and sonar at sea recordings including numerous deployment cycles. Evaluation results will be used to refine the prototype into an initial design that will meet Navy requirements. The company will prepare a Phase III development plan to transition the technology to Navy use.

PHASE III: The company will be expected to support the Navy in transitioning the Automated Acoustic Monitoring System for Navy use. The company will further refine the Automated Acoustic Monitoring System according to the Phase III development plan for evaluation to determine its effectiveness in an operationally relevant environment. This could potentially transition to any AxB platform which includes surveillance platforms, surface platforms and submarines. The company will support the Navy for test and validation to certify and qualify the system for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Automated Acoustic Sensor Monitoring technologies developed under this topic offer many commercial opportunities where underwater acoustic sensors are utilized including commercial sonar systems (manned and autonomous), oil exploration, fishing industry, etc.

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KEYWORDS: Acoustic performance prediction; array self-noise; sensor performance; performance monitoring fault localization; sensor monitoring; condition based maintenance

TPOC: Meg Stout
Phone: (202)781-4233
Email: meg.stout@navy.mil
2nd TPOC: Richard Guthrie
Phone: (202)781-4378
Email: richard.guthrie@navy.mil

N151-031 TITLE: Automated Visual Location Fix for Submarine Navigation

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PEO IWS 5, Undersea Warfare Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an automated visual location fix capability for submarine navigation systems that detect and recognize navigation aids used for visual fix.

DESCRIPTION: The Navy has a need for an automated fix capability in submarine combat systems. This capability will aid the submarine navigation team in decision-making and recommendations to the bridge while piloting the submarine in and out of ports.

Navigation of submarines in and out of port can be challenging due to local boating traffic and littoral water hazards. Submarine navigation teams use navigation aids to make visual fixes to determine submarine location (ref. 1). This process can be both time-consuming and error-prone. The Navy seeks to automate the visual fix process to aid navigation, team decision-making, and recommendations to the bridge. The use of digital imaging systems in submarine periscope masts allows the potential of automated pattern recognition technologies (ref. 2) for recognizing and localizing navigation aids. Automated pattern recognition is complicated by the fact there are a wide variety of types, shapes, colors, and sizes of navigation aids existing in US coastal waters (ref. 3) and around the world today. The sheer number of navigation aids around the world, as well as environmental conditions and visual occlusion also add to the degree of difficulty in the development of an automated fix capability.

An innovative approach is needed to provide an automated visual location fix capability while piloting a submarine. The algorithm(s) should be capable of operating on video from the full spectrum of imaging sensors including visible color, near infrared, short wave infrared (SWIR), and mid-wave infrared.

PHASE I: The company will develop concepts for an Automated Visual Fix capability that meet the requirements discussed in the topic description. The company will demonstrate the feasibility of the concept in meeting Navy needs and will establish that the concept can be feasibly developed into a useful product for the Navy. The company will work with the Navy to identify metrics for measuring performance of a prototype Automated Visual Fix capability. Testing and analytical modeling will establish feasibility.

PHASE II: Based on the results of Phase I, the company will develop a software prototype of the Automated Visual Fix algorithm for evaluation. The prototype will be evaluated to determine its capability in meeting Navy requirements for an Automated Visual Fix capability. The final Phase II implementation of the algorithm shall operate on standalone Commercial off the Shelf (COTS) hardware, ready for a land based demonstration using actual periscope data. Capability performance will be demonstrated through prototype testing and evaluation on real periscope data provided by the Navy. The prototype shall effectively demonstrate an improvement over the manual visual fix process using the metrics defined in Phase I. Evaluation results will be used to refine the prototype into an initial design that will meet Navy requirements. The company will prepare a Phase III development plan to transition the technology to Navy use.

PHASE III: The company will be expected to support the Navy in transitioning the technology for Navy use. The company will develop an Automated Visual Fix capability according to the Phase III development plan for evaluation to determine its effectiveness in an operationally relevant environment. The company will support the Navy for test and validation to certify and qualify the system for Navy use. The target platform for this technology is the Integrated Submarine Imaging System (ISIS) system (AN/BVY-1). The target transition program is the Advance Processor Build (APB) program, the current modernization process for submarine combat systems.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: An automated visual fix capability should easily be applicable to both commercial and military vessels. Commercial fishing vessels can potentially use this technology to navigate in and out of port.

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KEYWORDS: Automated visual location fix; pattern recognition; navigation aids; image processing; digital imaging systems; visual occlusion

TPOC: Kenneth Pietrzak
Phone: (401)832-7847
Email: kenneth.pietrzak@navy.mil
2nd TPOC: Jose Barbosa
Phone: (401)832-7032
Email: jose.g.barbosa@navy.mil

N151-032 TITLE: Submarine Navigation in a GPS-Denied Environment

TECHNOLOGY AREAS: Ground/Sea Vehicles

ACQUISITION PROGRAM: PMS435, Submarine Electromagnetic Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an innovative approach to allow position fixing via existing outboard submarine sensors or new inboard sensors.

DESCRIPTION: GPS information is used to accurately localize position during navigation. In the event GPS information is not available, an alternate solution is desirable to allow for accurate position fixing. The goal of this effort is to provide the submarine an alternate method for accurate geo-positioning when GPS is unavailable. Current practices rely on GPS signals received by sensors in the submarine antenna and basic navigational techniques (ref 1).

The solution is preferred to make use of existing sensors – imagers, antenna, gyroscopes, etc., with only limited allowance for new associated inboard hardware support equipment (6 to 8 inches in a 19 inch diameter rack that could be located inside the submarine hull which allows for more flexibility).Solutions using existing available information from the fielded masts will always be more desirable.

This SBIR topic seeks innovative ways to calculate position either within the constraints given above or through newly developed approaches. Examples such as, but not limited to, the magnetic fields (ref 3), astronomical observations (ref 2), and lighting are all examples of desirable solutions. Use of active transmissions is not acceptable.

PHASE I: The company will determine the feasibility of concepts for a non-GPS based above water submarine navigation method. The company will determine the optimal solution for achieving the performance goals based on testing/analytical modeling and technical risk analysis.

PHASE II: Based on the results of Phase I and the Phase II contract statement of work, the company will develop a scaled prototype (either software demonstration or sensor for proof of concept). The prototype will be evaluated to determine its position accuracy. System performance will be demonstrated through prototype evaluation and modeling or analytical methods. Evaluation results will be used to refine the prototype into a design that will meet Navy requirements. The company will prepare a Phase III development plan to transition the technology to Navy use.

PHASE III: If Phase II is successful, the company will be expected to support the Navy in transitioning the technology through the Navy’s Advanced Processor Build (APB) or Technology Insertion (TI) process. The company will integrate the architecture into a prototype where it will be evaluated against requirements in a realistic scenario. The company will support the Navy for test and validation to certify and qualify the system for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: GPS localization is used extensively in commercial applications such as trucking, mapping, shipping, and potentially in the future, air traffic control; were GPS signals to be unavailable, there would be great impact on systems using position In addition, electromagnetic interference may limit use of GPS signals in some environments. Given the huge commercial market in GPS devices, there is clearly opportunity for alternate solutions to position fixing.

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KEYWORDS: GPS-denied; passive navigation; geolocation; stellar imaging; geographic localization; global positioning

TPOC:	Eric Rabe
Phone:	(401)832-8037
Email:	eric.rabe@navy.mil
2nd TPOC:	Jose Barbosa
Phone:	(401)832-7032
Email:	jose.g.barbosa@navy.mil

N151-033 TITLE: Using Environmental Information in State Estimation for Undersea Systems

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PEO IWS 5, Undersea Warfare Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an automated state estimation capability for undersea systems that exploits physical environmental characteristics to improve target motion analysis (TMA) and to avoid detection through exploiting the environment.

DESCRIPTION: A submarine is vitally dependent on its acoustic sensors during periods of total submersion. Because of this, collecting, associating, and assimilating acoustic data to generate the tactical and operational picture depends greatly on the effects of the acoustic environment. While acoustic tactical decision aids have been available and in use for years, currently limited research and development is available to reliably exploit environmental information in an automated manner to improve contact range and velocity estimation processes.

This topic will pursue more fully automated signal and information processing techniques to leverage environmental knowledge such as propagation paths, boundary interactions, and other physical phenomenon to aid in target localization and state estimation using acoustic sensors. Data comes from multiple sources in-situ both organic (onboard) and non-organic (off board); then there are historical databases of the environment. These are all to be considered as part of this effort. State estimation, as commonly referred to in the tracking and fusion literature, is defined as a quantitative statement of an object's position and velocity with a principled quantified characterization of uncertainty of these values as well as the possible inclusion of the target's spectral properties. The small business should document the quantification methods and processes as part of their concept. Successful efforts must deal with uncertainties in the environment and physical processes affecting acoustic source localization (ref 1). The Navy is pursuing innovative approaches to exploiting information about the environment to enable the Navy to estimate the distance to a contact held on passive radar.

The physics of undersea acoustic propagation are well understood, a number of numerical and closed form methods exist that can be employed to aid both the operator and automated tracking and fusion processes to reduce target state estimate uncertainties (ref 2). Approaches that address these physical processes directly in determining state estimates are more desirable than approaches that attempt to condition state estimates to account for the environment after the estimates are produced, since such approaches rarely address the accrual of environmental information over time.

Efforts to improve state estimation can benefit from environmental information, such as the existence and location of convergence zones as well as indications of ranges that are not possible because of an acoustic path blocked by some bathymetric feature (ref 3). For example, the initialization of a target state estimate or "solution" stands to benefit from the use of this information once properly characterized in terms of the confidence in environmental knowledge.

Of great importance to any concept, transitioning to operational use will be a means to provide confidence to the Command Team and crew that environmental processing is working correctly and accurately. The Navy is looking for innovative approaches to estimate the reliability of environmental data and processing efforts on target localization and state estimation. A critical factor for success is then a demonstrable means for the concept to provide transparency to the operator on all facets of the environmental effects on the state estimation. In addition to this transparency, a means to "self-regulate" is of equal importance. We define self-regulation as the property of the system to assess inputs and accurately characterize its fused contact output in terms of uncertainty or confidence. Empirical and analytic techniques for this self-assessment are well known [refs 4, 5]. A successful concept must then self-regulate to report when operational thresholds for confidence are not satisfactory to remain under automated contact fusion. Effective approaches will provide a means for rapid and effective operator interaction with the system to act when manual attention is required.

PHASE I: The company will define measurable criteria for an automated State Estimation capability as described above. The company will demonstrate the feasibility of the concept in meeting Navy needs and will establish that the concept can be feasibly developed into a useful product for the Navy. Testing and analytical modeling will establish feasibility.

PHASE II: Based on the results of Phase I and the Phase II contract statement of work the company will develop a prototype for evaluation. The prototype will be evaluated to determine its capability in meeting the Navy's requirements for the automated State Estimation capability as described above. System performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters. Evaluation results will be used to refine the prototype into a design that will meet Navy requirements. The company will prepare a Phase III development plan to transition the technology to Navy use. Phase II has the potential to be classified.

PHASE III: The company will be expected to support the Navy in transitioning the technology for Navy use. The company will develop an automated State Estimation capability according to the Phase III development plan for evaluation to determine its effectiveness in an operationally relevant environment. The company will support the Navy for test and validation to certify and qualify the system for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Technology developed under this effort could be of benefit to other areas significantly affected by environmental characteristics such as Active Sonar, Over-the-Horizon-Radar, Urban GPS, and similar operating environments.

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KEYWORDS: Submarine acoustic sensors; acoustic environment; exploiting environmental information; target localization; state estimation; automated tracking

TPOC: Dennis Ling
Phone: (202)781-2179
Email: dennis.ling@navy.mil
2nd TPOC: Tony Le
Phone: (202)781-2217
Email: tony.t.le@navy.mil

N151-034 TITLE: Active Signal Processing Enhancements for Classification of Low Signal-to-Noise Ratio (SNR) Sonar Signals in Doppler Clutter

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PEO IWS 5.0, Undersea Warfare Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop innovative signal processing algorithms for Doppler sensitive waveform processing that improve detection and classification.

DESCRIPTION: The Navy is seeking to develop signal and information processing for improved performance of Doppler processing in the presence of stationary clutter, ownship induced clutter, and active interference. Innovative signal and information processing algorithms are sought to improve overall performance for Continuous Wave (CW) pulsed waveform processing. Of particular interest are low Signal-to-Noise Ratio (SNR) signals near the clutter ridge. These approaches should seek to improve the probability of detection and classification, while decreasing false alert rate and operator workload. Approaches might include signal processing techniques such as beamforming or statistical signal processing [ref 3], mismatch filtering approaches [ref 4], and others. Information processing improvements may include feature extraction and processing, multi-target tracking, and operator tools and displays.

Mid-frequency pulsed active sonar (MF PAS) systems exploit the Doppler sensitivity of certain waveforms (for example narrowband CW pulses) to aid in detection and classification of submarine and torpedo targets. Spectrogram processing of beam time series data of CW pulses isolates stationary clutter (such as bottom clutter and volume reverberation) to frequency bins near zero Doppler offset. This results in the familiar zero Doppler clutter ridge. In theory, signal echoes with sufficient Doppler can be detected and classified with high confidence provided there is adequate frequency separation from the clutter ridge. In practice, the range-Doppler surface is cluttered by much more than stationary clutter. Own-ship motion leads to a spectral spreading of bottom reverberation, resulting in “shoulders” of elevated noise surrounding the clutter ridge [refs 1, 2]. This suppresses or masks weak contacts even when there is separation from the clutter ridge. Active interference from nearby transmitters appears as discrete broadband impulses in the processing band of interest. These and other sources of spectral splatter adversely affect detection, tracking, and classification capabilities. Adaptive beamformers have been used to reject interference and narrow the frequency extent of the clutter ridge, but are still subject to degraded performance in regions dominated by own-ship motion induced reverberation.

PHASE I: The company will develop signal and information processing concepts for improved performance of Doppler processing in the presence of stationary clutter, own-ship induced clutter, and active interference. The company will demonstrate the feasibility of the concepts in meeting Navy needs and show the feasibility of developing the concepts into useful products for the Navy. Analytical modeling and simulation may be used to demonstrate feasibility. Based on the results of the analysis, the company will determine which concept best meets Navy needs.

PHASE II: Based on the results of Phase I and the Phase II contract statement of work, the small business will develop prototype signal and information processes for evaluation as needed. The prototype will be evaluated to determine its capability in meeting Navy requirements for Mid-frequency active clutter reduction using selected government furnished information (GFI) data sets. Sensor performance will be demonstrated through comparison of results from the prototype methods to current system methods over the required range of parameters. Evaluation results will be used to refine the prototype into a design that will meet Navy requirements. The company will prepare a Phase III development plan to transition the technology to Navy use. It is likely that the Phase II work will require access to classified data.

PHASE III: If Phase II is successful, the company will be expected to provide support to the Navy in transitioning the technology for Navy use. The company will develop real-time computer code that implements the signal and information processing methods and associated computer integration code for evaluation to determine its effectiveness in an operationally relevant environment. The company will assist in integrating and testing the software in a real-time environment, or other advanced processor build program specified by the US Navy. The company will support the Navy in test and validation to certify and qualify the system for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Techniques to enhance detection and classification performance in reverberation dominated regions can provide improvement for many commercial applications of active sonar. Bathymetry mapping, fish finding, oil exploration, commercial salvage and rescue/recovery efforts all use active sonar in regions/environments subject to reverberation and interference.

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KEYWORDS: Active sonar; underwater acoustics; clutter reduction in SNR signals; sonar signal processing; low doppler detection; signal processing techniques for sonar

TPOC:	Meg Stout
Phone:	(202)781-4233
Email:	meg.stout@navy.mil
2nd TPOC:	Richard Guthrie
Phone:	(202)781-4378
Email:	richard.guthrie@navy.mil

N151-035 TITLE: Organic Submarine Multi-Sensor Fusion

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PEO IWS 5, Undersea Warfare Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an automated organic submarine multi-sensor data fusion capability for submarine sensor systems that meets submarine tactical group requirements.

DESCRIPTION: Submarine combat systems require manual processes and procedures to assimilate information gathered by physical sensors into a tactical picture. The tactical picture is used by a submarine's command team and crew to understand and respond to the operating environment. To generate the tactical picture, the submarine crew evaluates contact or track information across sensor classes for a number of factors related to similarities in kinematic and spectral properties. If properties across tracks are sufficiently correlated, contacts are "fused". This process provides more information for tactical level tracking to improve the track and reduce the number of contacts improving situational clarity and enabling the Submarine's command team and crew to understand and respond to the operating environment more effectively. Fully automated systems exist in a variety of DoD, DHS, and commercial systems. Radar systems are such an example. However, providing a unified tactical picture through sensors with weak range resolution, in contact rich environments while searching for weak and elusive targets, remains a difficult problem. Submarine sonar systems are an example of this. Providing a solution to this remains a difficult problem.

This topic pursues a software subsystem that would interact with the tactical system of a submarine to fully automate data fusion techniques to produce a tactical picture through association of contact information across multiple sensors, both acoustic and non-acoustic [ref 1]. Although automated association of all contacts all of the time is extremely difficult, if not impossible, there are many cases where sufficient information is available to produce high confidence associations and to improve the command teams understanding of a contact's position and velocity. For example, existence of strong narrowband content across spectrally overlapped acoustic sensors is useful to initiate and maintain association of two independent sensor level tracks for the purposes of generating a single composite fused contact.

The small business will need to develop a collection of physics-based techniques operating within a probabilistic framework designed to exploit contact features across both similar and dissimilar sensing systems [ref 2] and innovations on what data can be fused reliably. For example, it should be clear that acoustic data from an array of towed hydrophones is unlikely to share any spectral information with optical data from the periscope; however, environmental effects may encode closing geometry characteristics in both the acoustic and optical data. Also, for example, raw spectral information from a towed sensor may not permit a direct signature level correlation with a hull-mounted sensor due to separation in the operating spectra; however, known engine characteristics may allow the determination that these different separate spectral bands hold narrow band components of a common mechanical origin. The approach to interface with the hosting Tactical Control System should be best suited to the proposed data fusing concept(s) and should provide salient metrics to measure and monitor in-situ.

Like few other platforms, the submarine is vitally dependent on its sensors during periods of total submersion. Collecting, associating, and assimilating acoustic data to generate the tactical and operational picture is the highest priority. Means to use non-acoustic sensor data to compare and fuse acoustic evidence is desired for periods when the submarine is at periscope depth; however, this is a secondary consideration.

Of great importance to any concept transitioning to operational use will be a means to provide confidence to the command team and crew that the automated systems are working correctly and accurately. A critical factor for success is then a demonstrable means for the concept to provide transparency to the operator on all facets of the data collection, association, and assimilation. In addition to this transparency, a means to "self-regulate" is of equal importance. We define self-regulation as the property of the system to assess inputs and accurately characterize its fused contact output in terms of uncertainty or confidence. Empirical and analytic techniques for this self-assessment are well known [refs 3, 4]. A successful concept must then self-regulate to report when operational thresholds for confidence are not satisfactory to remain under automated contact fusion. Effective approaches will provide a means for rapid and effective operator interaction with the system to act when manual attention is required.

PHASE I: The company will develop a concept for an organic submarine multi-sensor data fusion capability that meets the stated requirements in the description section. The company will demonstrate the feasibility of the concept in meeting Navy needs and will establish that the concept can be feasibly developed into a useful product for the Navy. Simulated testing and analytical modeling will establish feasibility.

PHASE II: Based on the results of Phase I and the Phase II contract statement of work, the company will develop a prototype for evaluation. The prototype will be evaluated to determine its capability in meeting Navy requirements for the organic submarine multi-sensor data fusion capability. System performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters including but not limited to its ability to fuse data from multiple acoustic and non-acoustic sensors into correlated contacts, operate autonomously to provide a tactical picture of fused data contacts, interface with existing submarine Tactical Control Systems, provide salient metrics to measure and monitor contacts in-situ, and provide a means to determine/report confidence level of the automated data fusing contact reporting. Evaluation results will be used to refine the prototype into a design that will meet Navy requirements. The company will prepare a Phase III development plan to transition the technology to Navy use. Phase II has the potential to be classified.

PHASE III: The company will be expected to support the Navy in transitioning the technology for Navy use. The company will develop an organic submarine multi-sensor data fusion capability according to the Phase III development plan for evaluation to determine its effectiveness in an operationally relevant environment. The company will support the Navy for test and validation to certify and qualify the system for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Technology developed under this effort could be of benefit to areas such as persistent surveillance and homeland defense, where significant diversity of data types and minimal geometric perspective sensors makes finding and exploiting spectral and kinematic feature information difficult.

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KEYWORDS: Submarine combat systems; automated data fusion; assimilating acoustic data; automated association of contacts; acoustic sensors; non-acoustic sensors

TPOC:	Dennis Ling
Phone:	(202)781-2179
Email:	dennis.ling@navy.mil
2nd TPOC:	Tony Le
Phone:	(202)781-2217
Email:	tony.t.le@navy.mil

N151-036 TITLE: Next Generation Electronic Warfare Human Machine Interface (HMI) for Submarines

TECHNOLOGY AREAS: Ground/Sea Vehicles

ACQUISITION PROGRAM: PMS-435, Submarine Imaging and EW Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: To develop an intuitive, responsive, and open Human Machine Interface (HMI) system for Submarine Electronic Warfare (EW) AN/BLQ-10B (V) for increased operator efficiency and decision-making for submarine operators.

DESCRIPTION: The Navy seeks an innovative approach to improve machine-to-operator interfaces in both traditional and innovative displays for operator interaction with data and system functions to provide the most comprehensive and intuitive controls and displays for operator use. This system should provide easy integration with new applications and features to increase operator functionality without increasing the operator/system interaction. The system must be modular and easily extensible to allow for future growth as the AN/BLQ-10 adds or improves functionality and data sources.

The purpose of HMIs are to allow the EW operator to intuitively interact with the Radio frequency (RF) environment and reduce the operators' manual interaction with the system while significantly improving emission classification and correlation (ref 2). While the current submarine operational environment becomes increasingly complex and dense, the AN/BLQ-10 (submarine EW system) operator would be capable of providing accurate and timely information to the control room decision-makers for improved situational awareness. With the current submarine EW system becoming increasingly complex (coupled with a denser more complex electromagnetic operational environment), operators will need to have faster interaction with the system in ways that are more intuitive, and accurately show the electromagnetic environment allowing quicker data processing for decision-making and increased operator mission performance (ref 3).

The challenge for the EW operator is to provide the control room decision-makers with timely, relevant, and accurate reports to improve situational awareness. The solution should also focus on improved operational performance, effectiveness and operator workload reduction. These HMI modules must be able to consume and display organic (data collected from on board sensors) and inorganic (data that originates from off board sensors) data sets of varying types. Data sets can range from processed answers (sonar solutions, ESM emitter reports) to raw digital sets (Pulse Descriptor Words (PDW's), continuous digital intermediate frequency (IF) (CDIF), burst digital IF (BDIF), or In-phase / Quadrature (I/Q) data). These displays can range from processed near real time (NRT) data to real time (RT) data displays (ref 1,4).

During Phase I unclassified data sets of similar complexity and content to actual data will be utilized. During Phase II it is anticipated that work will require access to actual classified data sets and if necessary and available actual system access to for Submarine Electronic Warfare (EW) AN/BLQ-10B (V) may be provided.

PHASE I: The company will develop concepts for a Next Generation EW HMI for Submarines that meet the requirements as stated in the description section. At the completion of Phase I, determine technical feasibility, identify hardware and software architecture concepts with tradeoffs as well as system technical characteristics, and provide a cost analysis of the design. Develop and demonstrate design of key technology components. Establish Phase II performance goals (gradable metrics) and key developmental milestones.

PHASE II: Based on the results of Phase I and the Phase II contract statement of work, the company will develop a scaled prototype for evaluation. In the early part of Phase II, the performer will work with the government representatives to develop a test plan for prototype demonstrations in Phase II. The prototype will be evaluated to determine its capability in meeting Navy requirements for a Next Generation EW HMI for Submarines. System performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters, including various data sets and numerous deployment cycles. Evaluation results will be used to refine the prototype into a design that will meet Navy requirements. The company will prepare a Phase III development plan that will provide a detailed plan and method of implementation to a full scale system and what is required to transition the technology to Navy use.

PHASE III: If Phase II is successful, the company will be expected to support the Navy in transitioning the technology for Navy use. The company will develop a Next Generation EW HMI for submarines to determine its effectiveness in an operationally relevant environment. The company will support the Navy for test and validation to certify and qualify the system for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Government commercialization should be applicable across all EW platforms in the Navy. There is potential for other service / agency signals intelligence (SIGINT) systems to utilize these improved HMIs (Combat Sent, Rivet Joint, Global Hawk Ground Station, etc.). Commercial applicability could be used in the telecommunications (TELCOM) and Information Technology industries, and specifically with any RF mapping technologies, emitter detection and classification displays, etc.

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3. The Beginnings of Solid State Radar, Hyltin, T.M.; IEEE Transactions on Aerospace and Electronic Systems, Volume 36, Issue 3, Part 1, July 2000.

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KEYWORDS: Electronic Warfare Systems Human Machine Interface; Situation Awareness; Game Theory and modeling; Statistical Analysis, Intuitive Operator Interaction, Signal Analysis

TPOC:	Steven Henry
Phone:	(401)832-7849
Email:	steven.w.henry1@navy.mil
2nd TPOC:	Jeffrey Carvalho
Phone:	(401)832-3527
Email:	jeffrey.carvalho@navy.mil

N151-037 TITLE: Fat Line Tow Cable

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PMS401 Submarine Acoustic Systems Program Office

OBJECTIVE: Develop a submarine TB-16 Fat Line Array medium weight tow cable that uses the existing coaxial core that improve compressional ruggedness with modest-weight penalty, when compared to the existing TB-16 lightweight tow cable.

DESCRIPTION: The Navy seeks innovative strength member construction techniques for the TB-16 Fat Line Array tow cable that significantly improves axial compression and cut resistance. Since current lightweight materials in use today are unable to provide the needed compressional strength or resistance to external damage by fish hooks, new materials or application of existing materials for the solution will be needed to meet requirements. Currently available tow cables are either lightweight or heavyweight; there is no available material or construction technique which combines the best properties of each. It is recognized that available lightweight materials (such as Vectran, Zylon) require reinforcement that increases cable density, but the goal is to minimize the impact. The proposed solutions should retain existing coaxial core, and a modest weight increase is permissible.

A modest weight penalty relative to standard lightweight construction will still provide good depth separation between two towed arrays while minimizing the strum energy imparted onto the system. The proposed Fat Line Array tow cable shall be capable of withstanding 220 pounds of axially applied compressional loads that are imparted by the OK-276 fat line handling system, as well as being terminated within the diameter of the tow cable nose cone (3.35 inches). The new tow cable may have a 30% weight increase (as compared to existing light weight TB-16 tow cable) to allow for a more rugged tow cable, with the goal of withstanding axial compressional loads. These loads will be measured on the NAVY's land-based SSN OK-276 handling system located at NUWCDIVNPT in Newport RI. (Ref 1, 2 and 3). Additionally, the High Density Polyethylene (HPDE) currently used as a jacket material is easily cut by items such as fish hooks. Axial stiffness solutions that include making the cable more cut-resistant are greatly desired.

PHASE I: The small business will develop concepts that demonstrate substantially improved axial compressional resistance for the tow cable variant while providing a range of densities. Options should describe expected cut resistance improvements over the current HDPE. Each identified option should have a supporting simulation/calculation, showing relevant depth trail characteristics (towed array depth relative to tow platform over a range of speed and scope combinations). The small business will demonstrate the feasibility of the concepts in meeting Navy needs and will establish that the concepts can be feasibly developed into a useful product for the Navy. Feasibility will be established by material testing and analytical modeling.

PHASE II: Based on the results of Phase I and the Phase II contract statement of work, the small business will develop a prototype(s) for evaluation as appropriate. The prototype will be evaluated to determine its capability in meeting the performance goals identified above and the Navy requirements for Fat Line Array coaxial tow cables, such as survivability of 150 reeling cycles on the OK-276 handler with the dynamic seal in place These cables will be compliant with push-force requirement of 220 lbs. The Fat Line Array tow cable will be evaluated at both the raw cable level as well as the terminated cable level on the OK-276 LBTF and assessed for repeated handling cycles as well as compressional resistance. Modeling or analytical methods over the required range of parameters including numerous deployment cycles, tension and towing characteristics shall be performed. Evaluation results will be used to refine the prototype into a design that will meet Navy requirements and will be evaluated during a tow test while connected to a TB-16 Fat Line Array at Lake Pend Oreille, Idaho where Navy tow testing is performed. If successful, the small business will prepare a Phase III development plan to transition the technology to Navy use.

PHASE III: If the Phase II prototype is successful, the small business will be expected to support the Navy and array manufacturers in transitioning the new cable design into existing systems for Navy use. The small business will finalize the design of a tow cable for evaluation to determine its effectiveness in an operationally relevant environment. The small business will support the Navy for test and validation to certify and qualify the system for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: A medium-weight tow cable is applicable to surface Navy towed array programs. Additionally, oil and seismic exploration arrays could benefit from the innovative construction technique to better control the depth towing profile for varying geographic locations.

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KEYWORDS: Strength member construction techniques; towed array; Zylon; Vectran; tow cable for towed arrays; cyclic loading of radar arrays

TPOC: Margaret Biastre
Phone: (202)781-4058
Email: margaret.biastre@navy.mil
2nd TPOC: Todd Whitaker
Phone: (401)832-2148
Email: todd.whitaker@navy.mil

N151-038 TITLE: Submarine Meteorological Sensor

TECHNOLOGY AREAS: Ground/Sea Vehicles

ACQUISITION PROGRAM: PMS435, Submarine Electromagnetic Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an innovative approach to collect meteorological data for deep-diving submergible vessels in real time.

DESCRIPTION: The Navy is developing tools requiring access to meteorological data, such as humidity, wind, and temperature, for use aboard submergible vessels (1,4). Currently, a naval vessel can receive weather reports which may contain inaccurate or untimely data (2,3). Weather has a significant impact on undersea vehicle mission execution. Outside of its impact on navigation, weather is an umbrella term for a set of parameters that defines the atmospheric medium in which electromagnetic signals pass, be it radar signals, satellite signals, communication signals, and imaging signals, all of which are functions that are required within the mission space of an undersea vehicle. Undersea vehicles, either unmanned or submarines, currently have extremely limited ability to collect meteorological parameters. The capability proposed would be part of a command tool that would improve targeting, command and control of mission payloads, and situational awareness.

The Navy desires an innovative approach to obtain the following weather information in real time – humidity, wind speed and direction, atmospheric pressure, and sea/air temperature. Any sensors used would have to be survivable on a deep-diving vessel (and the inside of the submarine sail is free flooding), although data could be collected on the surface. Current state of the art sensors are not able to survive deep submergence. The solution could be a new survivable sensor, but making use of existing radar, antenna, or imaging systems has appeal as an approach as these systems do not require new components. In addition, disposable buoys, which make use of the existing ability to launch expendable three inch diameter buoys, would be an acceptable solution if cost effective. (less than $3,000 per unit in mass quantity).

The challenge for submarine-mounted meteorological sensors is to find a way for the sensors to survive the rigorous environment of submarines if left to the elements, and then be able to operate when exposed above the water's surface. The physics of meteorological sensors is predicated on the sensors being dry. Therefore, a way to keep the sensors dry or to have them quickly dry is paramount. Furthermore, the desired sets of meteorological parameters are not just localized to the near field (within a few feet), but also far field (i.e. out several miles). It would also be advantageous to vertically sample the atmosphere to locate and identify changes in atmospheric turbulence and properties over the viewable distance, which can impact electronic warfare operations and radar signals. The solution should be able to measure humidity, wind speed and direction, atmospheric pressure, and sea/air temperature in real time with an accuracy similar to state of the art land based sensors, can make use of existing sensor and launch systems if appropriate, and must cost under $3000 in mass quantity of a disposable sensor.

The Phase I effort will not require access to classified information. If need be, data of the same level of complexity as secured data will be provided to support Phase I work. The Phase II effort will likely require secure access, and NAVSEA will support the contractor for personnel and facility certification for secure access.

PHASE I: The Company will develop a concept for meteorological data collection aboard submergible vessels that meets the requirements described in the description section. The company will demonstrate the feasibility of the concept in meeting Navy needs and will establish that the concept can be feasibly developed into a useful product for the Navy. Feasibility will be established by testing and/or analytical modeling.

PHASE II: Based on the results of Phase I and the Phase II contract statement of work, the company will develop a prototype for evaluation. The prototype will be evaluated to determine its capability in meteorological data collection with similar accuracy for the parameters listed in the description. Performance will be demonstrated through prototype evaluation and modeling or analytical methods. The exact method of testing will vary depending on the design provided, but would include integration with land based submarine system test facilities if the design utilized these systems, testing with a land based three inch launcher (if appropriate) or localized in-water testing. Evaluation results will be used to refine the prototype into a design that will meet Navy requirements. The company will prepare a Phase III development plan to transition the technology to Navy use.

PHASE III: The Company will be expected to support the Navy in transitioning the Submarine Meteorological Sensor technology for Navy use. The company will develop the sensor in accordance with the Phase III development plan for evaluation to determine its effectiveness in an operationally relevant environment. The company will support the Navy for test and validation to certify and qualify the system for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Approaches to atmospheric data collection will be applicable to all seaborne vessels and remote or unmanned vessels operating in ocean environments.

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3. Stanton, Tim. “NPS Autonomous Ocean Flux Buoy Program.” Naval Postgraduate School. 2007.

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KEYWORDS: METOC; Meteorological Sensor; Atmospheric Sensor; Radiometric Data Collection; Remote Sensing; Expendable Buoy

TPOC:	Eric Rabe
Phone:	(401)832-8037
Email:	eric.rabe@navy.mil
2nd TPOC:	Jose Barbosa
Phone:	(401)832-7032
Email:	jose.g.barbosa@navy.mil

N151-039 TITLE: Compact, Low-Voltage, Multiple-Beam Electron Gun for High-Power Miniature Millimeter-Wave Amplifiers

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PEO IWS 2, Above Water Sensors

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a multiple-beam electron gun with permanent magnet focusing for a broadband, millimeter-wave amplifier with reduced size, weight, and power requirements.

DESCRIPTION: The Navy requires high-power, low-volume, reduced-weight, efficient and affordable millimeter-wave amplifiers for Electronic Warfare (EW) systems. The requirement for high power in a small, lightweight package is acute in some cases. Vacuum electronic devices have demonstrated the ability to deliver single-device powers in excess of projected solid-state amplifier powers, particularly at millimeter-wave frequencies. Millimeter-Wave (MMW) amplifiers are the key component in future transmitters used for electronic attack, high-data-rate communications, and radar. New and next-generation MMW transmitters must operate at higher frequencies and generate significantly higher RF power per unit mass than has been achieved today. The Navy needs innovative devices to provide mission-critical capabilities such as improved self-protection against emerging anti-ship missile threats, increased operating range, high communications data rates, and all-weather operation for diverse platforms (including small autonomous platforms). The Navy seeks an enabling technology for a new class of affordable, miniature, high-power MMW amplifiers suitable for multi-platform applications. This technology will ultimately increase MMW amplifier specific power density (defined as RF output power per unit size or weight) by more than a factor of five over the current state-of-the-art.

Vacuum electronic (VE) slow-wave amplifiers have a demonstrated ability to deliver single-device power well in excess of existing or projected solid-state amplifier power in the MMW range, with higher efficiency because of residual energy recovery by depressed electron beam collectors. High output power and low total power consumption make VE amplifiers very attractive for new systems. However, the most recent advances in the power and bandwidth of VE amplifiers have been for devices operating at moderate-to-high voltages (typically, above 15 kilovolts (kV)). These high operating voltages necessitate longer traveling-wave circuits and significantly increase the size and weight of the amplifier (particularly the permanent magnet focusing system) and the power supply. Lower operating voltages have obvious benefits in the size, weight, reliability, and cost of VE amplifiers. However, achieving high power at low voltage is quite difficult and generally requires a distributed electron beam (for example, multiple parallel beams) to achieve high current at low voltage. As an example of the impressive performance made possible by a low-voltage, multiple-beam approach, engineers at Istok Corporation, Russia, have reported 1-kiloWatt (kW) narrow-band amplifiers at frequencies of 15 -17 Gigahertz (GHz) (Ref.1). These amplifiers operate at voltages of a few kilovolts and have a specific power density of about 1 kiloWatt/kilogram (kW/kg) (including the magnet). Expansion of this low-voltage, multiple-beam technology to wide-band MMW slow-wave amplifiers has great potential for the development of lightweight, high-specific-power-density miniature traveling-wave tube (TWT) amplifiers suitable for applications on a wide variety of platforms. However, significant improvements in beam brightness are needed to transport the multiple beams through the smaller diameter beam tunnels required for higher frequency traveling-wave circuits.

To enable the development of high-power, compact, low-voltage MMW amplifiers, the Navy is seeking innovative electron gun and permanent magnet beam transport approaches based on multiple-beam technology. Compact, multiple-beam devices represent an emerging technology made possible by recent advances in three-dimensional computational modeling (Refs. 2, 3) and the development of advanced high-current-density thermionic cathodes (Ref. 4). The focus of this effort is development of the multiple-beam gun and corresponding permanent magnet design for integration with a compatible Ka-band circuit. The specific power density is a key metric. A successful design will exceed 500 Watts/kilogram (W/kg), which includes the weight of the magnets. The new technology will be consistent with a compact transmitter footprint with minimized system cost, and minimal beam interception from the electron gun to the collector. An expected by-product of the research and development of the hardware is the establishment of a design methodology, scalable in power and frequency, which makes use of and expands upon the potential of modern 3-Dimensional (3D) design codes.

PHASE I: The company will develop a concept for a multiple-beam electron gun and permanent magnet transport system that meets the requirements as stated in the description section. The company will demonstrate the feasibility of the concept in meeting Navy needs and will establish that the concept can be feasibly developed into a useful product for the Navy. Analytical methods or computational modeling will establish feasibility.

PHASE II: Based on the results of Phase I and the Phase II contract statement of work, the company will develop a prototype multiple-beam electron gun and permanent magnet transport system for evaluation. The prototype will be evaluated to determine its capability in meeting Navy requirements for the multiple-beam electron gun and permanent magnet transport system. Evaluation results will be used to refine the prototype into a design that will meet Navy requirements. The company will prepare a Phase III development plan to transition the technology for Navy use.

PHASE III: The company will be expected to support the Navy in transitioning the technology for Navy use. The company will develop the multiple-beam electron gun and permanent magnet transport system according to the Phase III development plan for evaluation to determine its effectiveness in an operationally relevant environment. The company will support the Navy for test and validation to certify and qualify the system for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Commercial applications of multiple-beam amplifier technology include broadband high-power amplifiers for commercial satellite up-links and point-to-multipoint wireless broadband “last mile” applications, where the low operating voltage is attractive due to reduced costs and increased reliability.

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KEYWORDS: Electron beam; millimeter-wave; permanent magnet; multiple-beam; vacuum electronic; slow-wave amplifier

TPOC:	Alexander Vlasov
Phone:	(202)767-0034
Email:	alexander.vlasov@nrl.navy.mil
2nd TPOC:	John Pasour
Phone:	(202)404-4975
Email:	john.pasour@nrl.navy.mil

N151-040 TITLE: Automated Visual Detection of Small Contacts on the Horizon

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PEO IWS 5, Undersea Warfare Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an innovative automated detection capability for Navy submarine combat systems to detect possible contacts at long ranges at, or near, the horizon.

DESCRIPTION: The Navy seeks an automated visual detection software capability to improve 360-degree situational awareness for its submarine fleet. Littoral operations frequently involve navigating around a large number of marine contacts, such as fishing fleets, which may be intermingled with potentially hostile targets. Manual visual detection of small contacts and long-range contacts on, or near, the horizon from low vantage points while sweeping the periscope through 360 degrees is difficult for periscope operators. Environmental conditions on the ocean can make the manual contact detection process even more difficult. Commercial radar used by ships for situational awareness cannot be applied to submarines at periscope depth. Digital imaging systems offer the potential for rapid and accurate contact detection at longer ranges than manual visual detection. Previous attempts at visual ship detection have been limited to larger contacts, high vantage points, and other imaging systems such as buoy cameras and stationary cameras in port (Ref 1-3).

Innovative approaches of automatic detection of small and/or long-range contacts at or near the horizon in difficult operating conditions including choppy seas, low visibility, and a variety of weather conditions is needed. Contact sizes in the image may be approximately tens of pixels or less. The algorithms should be capable of operating on video from the full spectrum of imaging sensors including visible color, near infrared, short wave infrared (SWIR), mid-wave infrared (MWIR), and long-wave infrared (LWIR) sensors in multiple formats including standard and high definition. The preferred implementation of these algorithms is in the form of a software program capable of running on general-purpose processors.

PHASE I: The company will develop concepts for an innovative automated detection capability that meet the requirements as stated in the description section. The company will demonstrate the feasibility of the selected concept in meeting Navy needs and will establish that the concept can be feasibly developed into a useful system for the Navy through testing and analytical modeling.

PHASE II: Based on the results of Phase I and the Phase II contract statement of work, the company will develop an innovative automated detection capability prototype for evaluation. The prototype will be evaluated to determine its capability in meeting Navy requirements for an innovative automated detection capability. Capability performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters. Evaluation results will be used to refine the prototype into an initial design that will meet Navy requirements. The company will prepare a Phase III development plan to transition the technology to Navy use.

PHASE III: The company will be expected to support the Navy in transitioning the technology for Navy use. The most likely transition path for these algorithms is insertion into the integrated submarine imaging system (ISIS) which is the Navy’s submarine image imaging system program of record and part of the submarine combat system. The company will further develop an innovative automated detection capability according to the Phase III development plan for evaluation to determine its effectiveness in an operationally relevant environment. The company will support the Navy for test and validation to certify and qualify the system for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Potential markets for this technology include port security and potential use on commercial vessels to complement the current radar technologies used for situational awareness.

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KEYWORDS: Automated detection of small contacts; buoy cameras; 360-degree situational awareness; manual contact detection process in port; visual ship detection; digital imaging systems

TPOC:	Ken Pietrzak
Phone:	(401)832-7847
Email:	kenneth.pietrzak@navy.mil
2nd TPOC:	Jose Barbosa
Phone:	(401)832-7032
Email:	jose.g.barbosa@navy.mil

N151-041 TITLE: Chart Data Overlay of Live Video for Submarine Navigation

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PEO IWS 5.0, Undersea Warfare Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an augmented reality view capability for live periscope video that creates a clearer view in littoral waters.

DESCRIPTION: The Navy needs an augmented reality capability that overlays chart data and navigation lines of concern on live submarine periscope video. Navigation of submarines in and out of port can be challenging due to local boating traffic and littoral water hazards. Modern submarines are now using the Voyage Management System, which supplies digital nautical charts to the submarine crew (ref. 1). The charts show all the buoys, aids, and hazards of navigation to the navigation team. The Navy seeks to improve this navigation capability further by overlaying chart data and navigation lines-of-concern onto live periscope video to create an augmented reality view when piloting. Adding these features will aid the navigation team decision-making and recommendations to the bridge. Augmented reality technology is being developed for several commercial and military applications (ref. 2). Commercial technologies include applications for smartphones that use the smartphone's Global Positioning System (GPS) and compass to display augmented reality markers for nearby restaurants, bars, and other businesses in real time. Professional football games are broadcast with augmented reality markers such as first down lines. The Navy seeks to leverage computer gaming technology and / or geographic information systems (GIS) to achieve this capability (ref. 3).

This topic seeks to identify innovative approaches to achieve an augmented reality view of periscope imagery while piloting a submarine. The algorithms should be capable of operating on video from the full spectrum of imaging sensors including visible color, near infrared, short wave infrared (SWIR), mid-wave infrared (MWIR), and long-wave infrared (LWIR) sensors in multiple formats including standard and high definition. The preferred implementation of this algorithm(s) is in the form of a software program capable of running on general-purpose processors.

PHASE I: The company will develop concepts for the augmented reality view as stated in the description section. The company will demonstrate the feasibility of the selected concept in meeting Navy needs and will establish that the concept can be developed into a useful product for the Navy. Testing on unclassified sea-based imagery and/or synthetic data along with pertinent charts and other navigation data will establish feasibility. The Navy can provide some unclassified periscope video to support this effort.

PHASE II: Based on the results of Phase I and the Phase II contract statement of work, the company will develop an augmented reality view for live periscope video prototype for evaluation. The prototype will be evaluated to determine its capability in meeting Navy requirements for an augmented reality view. Algorithm performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters. Evaluation results will be used to refine the prototype into a design that will meet Navy requirements. The company will prepare a Phase III development plan to transition the technology to Navy use.

PHASE III: The company will be expected to support the Navy in transitioning the augmented reality view for live periscope video technology for Navy use. The company will develop an augmented reality view according to the Phase III development plan for evaluation to determine its effectiveness in an operationally relevant environment. The company will support the Navy for test and validation to certify and qualify the system for Navy use. The augmented reality capability developed under this topic will transition through the Advance Processor Build process and reside on the Integrated Submarine Imaging System (ISIS) system.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: There is a large commercial market for augmented reality products that may be able to use some of the technology developed with this topic, including smartphone applications and broadcast television. Video-based augmented reality navigation systems could benefit merchant ships and other military vessels as well.

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KEYWORDS: Augmented reality view; piloting a submarine; Voyage Management System; periscope video; chart data overlay for submarine navigation; geographic information system

TPOC: Kenneth Pietrzak
Phone: (401)832-7847
Email: kenneth.pietrzak@navy.mil
2nd TPOC: Jose Barbosa
Phone: (401)832-7032
Email: jose.g.barbosa@navy.mil

N151-042 TITLE: Thin Walled Corrosion Resistant Steel (CRES) Pipe Proactive Joint Reinforcement

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: PMS 312, In-Service Aircraft Carrier Program Office and PMS 378/379, Future

OBJECTIVE: The objective is to develop an innovative technology that prevents leakage in a thin walled CRES welded joints within Jet Propulsion Grade JP-5 fuel lines by proactively reinforcing the joints before they leak.

DESCRIPTION: Thin walled CRES 316L pipe (ref. 1) has been used in JP-5 fuel systems (ref. 2). The pipe joint design uses a belled end fitting creating an inherent crevice. The thinness of these pipes may lead to poor weld quality at the pipe joints which could cause additional crevices within the pipe joint. Crevices create areas for corrosion to form and may eventually result in leakage at the weld joints. Thin walled CRES pipe is currently on other ships in the Fleet and there is a need to create an easily applied method to proactively reinforce the welded joints to preclude any leak that may result from possible crevice corrosion without causing further damage to the pipe. In many instances, there is often limited access space surrounding the pipe joint.

Pipe joint leakage failures were identified on CVN 77 within the first three years of service. The JP-5 fuel system installed on CVN 77 and planned for all FORD Class Carriers have over 28,000 welded joints per ship. Unpredictable failures are expected to occur. A proactive approach to reinforce the thin walled CRES pipe joint at the weld will prevent leaks from occurring..

Any material and technique developed must be safe for use in fuel piping and applicable to pipe sizes ranging from 2 to 12 inches. Joint types include couplings, tees and elbows, which may be made using sockets or belled end fittings. The joint reinforcement for the intended pipe system must be able to withstand internal pressures up to 190 psi and tolerate contact with JP-5 fuel without contaminating the fuel or weakening the reinforcement. In addition, many pipe joints are located in confined spaces on the ship, which may pose a challenge for installation of a reinforcement method. The targeted goal for life expectancy of the joint reinforcement is the life of the ship (50 years) with a threshold life expectancy of 25 years. Currently, there is no product known to the Navy available to meet this need.

The thin walled CRES pipe proactive reinforcement shall achieve the competing objectives of providing a cost effective leak preventive solution, efficient application and installation methods, and lower maintenance cost ($15k objective and $20k threshold total costs per joint for a 3” pipe when replacing multiple joints). This topic is not intended to require a repair concept to stop an existing leak, but rather to reinforce a weakened pipe joint. While it is desirable for this joint reinforcement concept to be applied while the ship is underway, it is not required.

Epoxy resin patches and welding options are already available to repair defective pipe joints and provide pipe reinforcement. A variety of damage control for fuel lines related leak repairs exist. However, the damage control related repairs are expensive and generally do not provide a permanent repair (ref. 3). Composite materials could be used for this pipe repair application (ref. 4). The bulk of research into this area is directed at large pipe repair for the petroleum or construction industry where metal sleeves are an option (ref. 5). Although this type of sleeve may not be an option for this application, the related research may be helpful. Another potential area to investigate is metal deposition which can be applied similarly to welding (ref. 6) or applied with high pressure gas (ref. 7 and 8).

PHASE I: The company will develop a concept for an inexpensive and easily applied thin walled CRES pipe proactive joint reinforcement that can withstand pipe pressure up to 190 psi and tolerate contact with JP-5 fuel. The concept should demonstrate how the reinforcement could be applied with limited access to the pipe joint. The concept should also present reasonable cost estimates for the reinforcing technique to prevent leakage. Feasibility will be established by material testing and/or analytical analysis/modeling.

PHASE II: Based on the results of Phase I and the Phase II contract statement of work, the small business will develop a prototype for evaluation. The prototype will be evaluated to determine its capability in meeting the performance goals identified in the Phase II work plan and the Navy requirements for the thin walled CRES pipe proactive joint reinforcement. Reinforcement performance will be demonstrated through prototype evaluation, modeling and/or analytical methods over the required range of parameters including numerous deployment cycles/simulated longevity tests. Evaluation results will be used to refine the prototype into a design that will meet Navy requirements. The company will prepare a Phase III development plan to transition the technology for Navy use.

PHASE III: The company will be expected to support the Navy in transitioning the technology for Navy use. The company will develop a thin walled CRES pipe proactive joint reinforcement according to the Phase III development plan for evaluation to determine its effectiveness in an operationally relevant environment. The company will support the Navy for test and validation to certify and qualify the system for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: If successfully demonstrated, there may be a commercial market for this thin walled pipe joint reinforcement in any industry that employs thin walled CRES piping, such as petroleum production or distribution.

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KEYWORDS: Thin Walled CRES; Reinforce the welded joints; Welded pipe joints; Leakage across pipe joints; Pipe reinforcement; Damage control for JP-5 fuel piping; JP-5 fuel

TPOC: Dan Jent
Phone: (202)781-3387
Email: daniel.jent@navy.mil
2nd TPOC: Liz Perry
Phone: (202)781-2394
Email: elizabeth.c.perry@navy.mil

N151-043 TITLE: Undersea Vehicle Navigation

TECHNOLOGY AREAS: Ground/Sea Vehicles

ACQUISITION PROGRAM: PEO SUBS PMS 485, Maritime Surveillance Systems, Distributed Sensors Group

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an inexpensive embedded navigation tracking system for a small unmanned, bottom contact, undersea vehicle.

DESCRIPTION: The Department of the Navy (DoN) is developing an undersea burial vehicle that crawls at approximately 0.5-knots along the ocean bottom burying ¼ to ½-inch (in) diameter cable up to 1-kilometer (km) long. An inexpensive navigational system is necessary to provide accurate location inputs to the vehicle controls system. Desired accuracy is plus or minus (±) 6-in along a notional 1-km track. Current navigational systems for undersea vehicles have the potential to provide this degree of accuracy but are prohibitively expensive for the targeted DoN system that is a one-time use, expendable burial vehicle.

The objective is to produce a small, low power, short operational life, highly accurate inertial navigation system for under $5K production cost. Current high accuracy systems integrate multiple sensors and systems such as Inertial Navigation System (INS) (References 1 and 2), Doppler Velocity Log (DVL) (Reference 3), and Global Positioning System (GPS) (Reference 4) to achieve high accuracy standards (References 1 and 2). GPS does not work through sea water. Optical systems require image matching, which is not available.

This SBIR is looking for innovative and inexpensive methods to track the path of the vehicle and provide position data to the navigation controller. The navigation system is size-, weight- and power-limited. It should not consume more than 20-watts continuous power for the mission and needs to fit into a 4-in cubed (i.e., 64 cubic inch) volume within the undersea vehicle.

PHASE I: The Company will develop a concept for an improved Undersea Vehicle navigational tracking and feedback system that meets the requirements as stated in the description section. The company will validate the concept and demonstrate the feasibility of the concept in meeting the Navy needs. Feasibility will be established by analytical modeling.

PHASE II: Based on the results of Phase I and the Phase II contract statement of work, the company will develop a prototype navigation tracking system for evaluation. The prototype will be implemented in a mock vehicle mission with test cable and evaluated to determine its capability in meeting Navy requirements of Undersea Vehicle Navigational Tracking and Positional System. Performance will be demonstrated through lab or at-sea testing at a range suitable for easy measurement of results. Evaluation will be conducted by comparing and validating navigation tracking results to measured results in the range over multiple lay downs.

PHASE III: The company will be expected to support the Navy in integrating the Undersea Vehicle Navigational Tracking and Positioning system into the targeted DoN system to determine its effectiveness in an operationally relevant environment. The company will support the Navy for at-sea test and validation to certify and qualify the system for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The undersea vehicle navigational tracking and positioning system will be useful in any industry that needs autonomous vehicles such as the gas and oil industry, as well as Department of Homeland Security (DHS) in monitoring ports and coastal waters.

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KEYWORDS: Unmanned undersea vehicle navigation and control; Unmanned undersea vehicle positioning; Inertial navigation; Autonomous undersea vehicle navigation and control; Unmanned Undersea Vehicles; Vehicle Navigation

TPOC: Steve Whiteside
Phone: (619)553-1502
Email: steve.whiteside@navy.mil
2nd TPOC: John Curtis
Phone: (619)524-7248
Email: john.e.curtis@navy.mil

N151-044 TITLE: Electro-Optical Infrared (EO/IR) Imaging System to Improve Navigation

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PMS377, Landing Craft, Air Cushion (J-Division) and Ship to Shore Connector

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a durable and low cost Electro-Optical (EO)/Infrared (IR) imaging device for the operators of the Navy’s Air Cushion Vehicles (ACVs).

DESCRIPTION: Air Cushion Vehicles (ACVs) conduct day and night, off-shore, near-shore, and on-shore missions. Operational and safety navigation requirements dictate that craft operators maintain situational awareness in littoral environments during periods of daylight, twilight, and darkness. Operators must also be able to see through sea spray, high humidity, haze, smoke, and dust. Currently, situational awareness on the Landing Craft, Air Cushion (LCAC) is achieved through the use of craft mounted Radio Detection and Ranging (RADAR), visual watches, and night vision devices.

A critical element to the successful and safe execution of low visibility, day or night missions is providing the craft crew with a clear picture of the environment around and in front of the craft allowing them to develop and maintain situational awareness. This is currently provided on LCAC by RADAR which, while effective in detecting contacts in the off-shore environment, becomes less and less effective in the near-shore environment and is ineffective during on-shore operations. Currently, RADAR shortcomings are offset by the use of night vision goggles. Additionally, the helmet mounted night vision goggles have performance limitations resulting in incomplete situational awareness and have been linked to spine and neck injuries following periods of extended use.

Surface RADAR performance in littoral environments is adversely affected by terrain features (such as excessive RADAR Radio Frequency (RF) energy gain return and land masking, video drag from elevated land features, and low operator recognition differential in areas of low elevation and flat terrain). Surface RADAR performance is further degraded by atmospheric contaminants (smoke and dust) and high humidity or spray. Additionally, RADAR does not detect all surface contacts and does not have the ability to classify or identify contacts. Night vision goggles have range and ambient light limitations, and are adversely sensitive to smoke and dust. The current capability limits the Warfighter’s ability to identify friendly or hostile surface or land based contacts. This limitation results in a reduction of craft speed, causing increased vulnerability to shore threats (such as coastal artillery) and increased off-load time.

An EO/IR system (or similar hyper spectral imaging sensor) should greatly increase operator situational awareness by providing the ability to discern land terrain, sea, and waterway features and contacts, such as small boats and patrol craft in the near-shore environment where surface RADAR performance is limited. A hyper spectral imagery system with thermal contrast, such as an EO/IR sensor, will provide capability to detect and identify surface contacts (fiberglass, composite boats, and others), and beach borne and land-based threats (hostile tactical vehicles) that have very low RADAR signatures. The unique capabilities of a combination of electro-optical imagery, infrared imaging, night vision systems, and laser and range finding tools will enhance ACV combat operations (ref #1). Combining infrared-imaging sensors with electro-optical imagers can potentially lead to systems that are effective during both day and night operations (ref #2). Navigation safety and the crew's ability to detect and track surface contacts will be improved, enabling ACVs to operate at higher speeds and enhance mission capability.

PHASE I: The company will define and develop a concept for an EO/IR System that meets the requirements as stated in the topic description. The company will demonstrate the feasibility of the concept in meeting Navy needs and will establish that it can be developed into a useful system for the Navy. Feasibility will be established by material testing and analytical modeling.

PHASE II: Based on the results of Phase I and the Phase II contract statement of work, the company will develop, demonstrate, and validate a prototype EO/IR system for evaluation. The prototype will be evaluated to determine its capability in meeting Navy requirements for the EO/IR system. The prototype will undergo an operational demonstration on a Landing Craft, Air Cushion (LCAC) in order to evaluate and determine system performance. Evaluation results will be used to refine the prototype into a design that meets Navy requirements. The company will prepare a Phase III development plan to transition the technology to Navy use.

PHASE III: If Phase II is successful, the company will be expected to support the Navy in transitioning the system for Navy use. The company will refine the design of the EO/IR system, according to the Phase III development plan for evaluation to determine its effectiveness in an operationally relevant environment. The company will support the Navy for test and validation to certify and qualify the system for Navy use and for transition into operational LCACs.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The EO/IR system described in this SBIR topic paper could have private sector commercial potential and dual-use applicability for any ship or craft operating in the near- or on-shore environment, and vehicles operating on-shore. Riverine operations would benefit from an enhanced system. Commercial hovercraft, ferries, pilot boats, and transports would also benefit from the development of this system.

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KEYWORDS: Infrared (IR); Electro-Optical (EO); Radio Detection And Ranging (RADAR) for landing operations; night vision; imaging device to determine terrain features; navigation of LCACs; safety during beach landings; and combat enhancement

TPOC: Troy Landry
Phone: (202)781-5191
Email: troy.d.landry@navy.mil
2nd TPOC: Robert Holmes
Phone: (202)781-3179
Email: robert.t.holmes@navy.mil

N151-045 TITLE: Submarine Component Design Tool to Assess Relative Resistance to High

Intensity Loading

TECHNOLOGY AREAS: Ground/Sea Vehicles

ACQUISITION PROGRAM: PMS 397, OHIO Replacement for reduction in non-recurring engineering costs

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an innovative and cost-effective automated software design and qualification tool to comparatively assess submarine components ability to withstand high intensity loadings.

DESCRIPTION: The Navy requires submarine components, internal and external, to withstand a specified level of high intensity loading to comply with shock requirements (ref 1). Compliance with shock requirements is accomplished through standard testing or detailed analyses that seek to estimate the response of components to high intensity loading in an absolute sense. In special cases where a new component is shown to be similar to a previously shock qualified component, its ability to withstand high intensity loading may be demonstrated by a comparison to the previously shock qualified component. This comparison process is defined as shock qualification by extension. Though an extension is the lowest cost option in shock qualification, it has limited use as a design tool. This SBIR seeks innovative and cost-effective design means which will allow equipment manufacturers to design equipment without the need for high cost testing or forcing the design to be similar to older, previously qualified items.

The developed means of comparison must account for ranges of potential differences in components including physical differences, mounting conditions, and orientations. A successful assessment method will address parameters relevant to high intensity shock loadings (ref 2,3) and will be developed into an automated software tool that, when coupled with the knowledge of qualified component and new component properties, can be implemented by a designer or Navy engineer to determine which of the two components is more resistant to high intensity loadings. The process and methodology envisioned to get a solution in today's digitally designed environment qualification by Finite Element Analysis (FEA) enables another tool to be developed to compare a qualified design with a modified design. That comparison tool will allow one to approve or disapprove the new modified design – thereby eliminating a whole new FEA or test program. FEA uses stress analysis to determine pass/fail. This new tool will compare stresses between the two models.

The automated software tool will be used as a design development tool in the design phase of submarine programs and, if applicable, as a shock qualification tool. A successful automated software tool will reduce submarine design costs by tens of millions of dollars and be a catalyst to submarine component adaptively. This can be demonstrated using any number of test parameters for the sake of proving a concept before using real (and potentially classified) or simulated data.

PHASE I: The company will define and develop a concept for an automated software tool to perform comparative assessments of submarine components resistance to high intensity loading to include the relevant metrics used in quantifying a component's ability to withstand shock. The company will demonstrate the feasibility of the concept in meeting Navy needs and determine its feasibility to be developed into a useful product for the Navy through analytical modeling.

PHASE II: Based on the results of Phase I the company will develop and execute a validation methodology for the automated software assessment tool. This includes building the prototype tool, which will be evaluated to determine its capability in meeting Navy shock requirements. Evaluation results will be used to iterate and refine the prototype design. The company will prepare a Phase III development plan to transition the technology to Navy use.

PHASE III: The company will be expected to support the Navy in transitioning the automated software comparative assessment tool for Navy use. The company will develop an assessment tool according to the Phase III development plan for evaluation to determine its effectiveness in an operationally relevant environment. The company will support the Navy during testing and validation to certify and qualify the system for Navy use and to transition the tool to its intended submarine program.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: A method, as implemented in an automated software tool, to quickly and quantitatively compare components or systems in their ability to withstand high intensity loading has applicability in vehicle loading and crashworthiness. These applications would be useful to the automotive and shipping industries. There are also potential uses in aerospace industries due to the high severity loads associated with launch or takeoff and landing, as well as high speed turbulence.

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KEYWORDS: Underwater shock test; shock qualification tool; dynamic loading; relative resistance; comparative analysis of relative resistivity; shock qualification by extension

TPOC:	Matthew Strawbridge
Phone:	(301) 227-4170
Email:	matthew.strawbridge@navy.mil
2nd TPOC:	Robert Atkatsh
Phone:	(202)781-2088
Email:	Robert.atkatsh@navy.mil

N151-046 TITLE: Low-Cost Gallium Nitride (GaN) on Diamond Semiconductors for Microwave Power Amplifiers

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PEO IWS 2, Above Water Sensors

OBJECTIVE: Develop a production process for GaN on diamond semiconductor wafers suitable for radio frequency integrated circuit (RFIC) fabrication to reduce cost and enhance performance.

DESCRIPTION: The purpose of this effort is to identify and develop an innovative GaN on diamond manufacturing process that serves to make high quality, RFIC-grade wafers available at competitive prices. The superior performance of GaN on diamond has been validated by testing representative circuits under laboratory conditions. Since the semiconductor itself is retained, circuit and processing design changes need not start from scratch, reducing risk. There are few (if any) technical arguments against adoption of GaN on diamond as a next-generation semiconductor for RFICs. However, GaN on diamond development has been restrained due to simply the availability of GaN on diamond wafers, the accompanying high cost, and the limited manufacturing base that is built on highly proprietary processes and has limited capacity. Industry has no current incentive to attack the cost of producing low cost GaN on diamond semiconductors due to the limited number of producers of the more expensive GaN on silicon.

Most future Navy sensors operating in the frequency bands L through X will be based on transmit/receive modules (TRMs) employed in large numbers, typically in phased array apertures (Ref. 1). In some future systems, particularly in radar, TRMs deployed on a single ship will number in the thousands, representing the predominant cost of the system. Within the TRM itself, the radio frequency (RF) power amplifiers are typically the single greatest component cost. Furthermore, the power amplifiers drive other considerations, such as the amount and means of cooling supplied to the TRM. Heat spreaders, heat pipes, special materials, and integrated cooling of the TRM package, attributable to the power amplifier, account for considerable cost associated with TRM design and manufacturing. Even modest changes to the power amplifier design have a cascading effect on total system cost.

The current state-of-the-art in power RF technology is the Gallium Nitride (GaN) semiconductor on a Silicon Carbide (SiC) substrate (Refs. 2, 3). When introduced, GaN technology represented a leap forward in performance due to the fundamental electronic properties of the material. Millions of dollars were invested to mature the basic manufacturing processes required to exploit the GaN technology for efficient, reliable, and affordable power amplifier designs. Today incremental advances in GaN on SiC manufacturing and design continue, however, the basic performance and cost of the technology has largely stabilized.

The next evolution of GaN technology for RF power amplifiers is GaN on diamond substrate (Ref. 4). That is, not a change to the semiconductor itself, but an improvement to the substrate, which is fundamental to the mechanical and thermal performance of the semiconductor. Diamond offers a significant increase in thermal conductivity over that of SiC, allowing circuit elements to be spaced more closely on the chip while dissipating heat more effectively to maintain operation at safe temperatures. Consequently, more Radio Frequency Integrated Circuits (RFICs) can potentially be obtained from a GaN on diamond wafer than from a corresponding GaN on SiC wafer (assuming equivalent yields). This has the potential for far ranging impacts, not just in cost, but in unprecedented performance as well. The enhanced thermal characteristics of GaN on diamond make it especially attractive for millimeter-wave RFIC designs where circuit elements are closely spaced.

The value of the process will be evaluated by comparison with the existing GaN on SiC state-of-the-art, both in technical parameters (wafer flatness, defect incidence, and others) and in cost. Product quality, process consistency and cost are paramount considerations.

PHASE I: The company will define and develop a concept for the production of GaN on diamond semiconductor wafers suitable for RFIC fabrication that meet the requirements stated in the topic description. The company will demonstrate the feasibility of their concept in meeting Navy needs and will establish that the concept can be feasibly produced. Scaled process testing, analysis and/or modeling will establish feasibility.

PHASE II: Based on the results of Phase I and the Phase II contract statement of work, the company will develop a prototype process for evaluation. The prototype process will be evaluated to determine its capability to meet Navy requirements for production of GaN on diamond semiconductor wafers suitable for RFIC fabrication. The GaN on diamond process will be demonstrated through prototype evaluation and/or modeling. Evaluation results will be used to refine the developed process prototype into a fully functional and operational production process that meets Navy requirements. The company will prepare a Phase III development plan to transition the technology for commercial use to supply Navy needs.

PHASE III: The company will be expected to produce GaN on diamond semiconductor wafers. The company will develop and fully document the production process of GaN on diamond semiconductor wafers suitable for RFIC fabrication according to the Phase III development plan. The production process will be evaluated to determine its effectiveness in full rate production of the wafers. This may require the small business to license other manufacturers for the actual production.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The US domestic RF semiconductor business supplies commercial as well as military markets, and advances in semiconductor and RFIC technology, though first implemented in military systems, eventually transition to commercial product lines. Since this topic seeks to develop a process for semiconductor material, and not a specific military application, the potential for commercial application is unfettered. The potential commercial market is essentially unlimited, should the technology prove cost competitive.

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KEYWORDS: Gallium Nitride; Silicon Carbide; diamond substrate; GaN on diamond; transmit/receive modules; Radio Frequency Integrated Circuits

TPOC: Lawrence Dressman
Phone: (812)854-4804
Email: lawrence.dressman@navy.mil
2nd TPOC: Chuck Pagel
Phone: (812)854-2382
Email: chuck.pagel@navy.mil

N151-047 TITLE: Innovative Data Compression Algorithms to Increase System Throughput Efficiency on Navy Ship-to-Shore Communication Networks

TECHNOLOGY AREAS: Information Systems

ACQUISITION PROGRAM: PMS505, Littoral Combat Ship Fleet Introduction and Sustainment Program Off

OBJECTIVE: Develop an innovative system for increasing data transmission compression of installed shipboard hardware to shore communications networks.

DESCRIPTION: An innovative technology is sought for throughput management and data compression to facilitate faster transmission of data over existing ship-to-shore communication networks. This topic seeks a transmission technique for ship and system maintenance related data generated and available on board the LCS to shore sites because there are not enough sailors onboard to actually monitor and maintain the equipment on board LCS. The data paths and links available on LCS are monopolized by higher priority communications requirements. This topic is to define and prove a method to get this information off the ship to shore for monitoring thereby allowing for reduced manning onboard LCS. Off-board post-mission analysis and distance support require tremendously large amounts of data.

Post-mission analysis and distance support requires a tremendously large amount of data to be transmitted to shore based activities. LCS platforms rely on the Navy Information Application Product Suite (NIAPS) system to transmit much of this data using limited bandwidth capacity. Bandwidth limitations coupled with NIAPS replication times do not support the speed of delivery required for performance of shore based functions critical to support the minimally manned crew concept that is integral to the Littoral Combat Ship Concept of Operations. The limitation in shipboard data transmission capacity is the current choke point to the amount of distance support and post mission analysis that can be conducted off ship.

A solution is sought that will combine the latest technologies of data compression and data replication while minimizing resource consumption across existing systems and any new design infrastructure. This solution should help manage transmission bandwidth while transferring data as it is gathered by searching for open bandwidth between higher priority data traffic instead of holding it for periodic transmissions ashore in larger bulk transfers. The major design goal is for the latest data compression technologies and data replication conventions to be coupled with an infrastructure that minimizes information technology (IT) resource consumption by defining suitable connections between systems, minimizing infrastructure changes and disruption of services among existing systems, and obtaining acceptable performance for multisystem data transfers ashore. Origination of the data and formats to be processed will be accomplished by the same hardware and software resources currently used in local system environments, however, recommendations for current system modifications should be made with performance considerations that minimize additional IT resource demands and configuration change.

Data compression is an enabling technology that will allow for greater data transmission across networks without significant increase in resources. There are several data compression algorithms which are available to compress files of different formats such as Shannon-Fano Coding, Huffman coding, Adaptive Huffman coding, Run Length Encoding and Arithmetic coding (Ref 1). Additionally, academic researchers have improved network bandwidth utilization by an order of magnitude using algebra to eliminate the network-clogging task of resending dropped packets of data. (Ref 2). Since LCS networks also carry many different types of services with varying digital formats and priorities, local mechanisms that allow these services to co-exist are complex and compete for off-ship bandwidth. Research on dynamic bandwidth allocation can prove beneficial towards balancing data (packet) delay through use of a traffic load-based allocation approach, which includes data weight and queue priority calculations (Ref 3). These approaches are examples of innovative techniques that, when coupled in development of a single solution, may satisfy the objectives of this topic.

PHASE I: The company will determine technical feasibility and develop a concept for an improved data compression algorithm for increasing voice and data transmission throughput and that meets the requirements stated in the topic description. The company will demonstrate the feasibility of the data compression algorithm concept and will establish that the concept can be feasibly developed into a useful product for the Navy. Feasibility will be established by analytical modeling.

PHASE II: Based on the results of Phase I, the small business will develop a data compression algorithm prototype for evaluation. The prototype will be evaluated to determine its capability in meeting Navy requirements to increase voice and data transmission throughput on Navy ship-to-shore communication systems. System performance will be demonstrated through prototype evaluation and operational demonstration on targeted communication systems. Evaluation results will be used to refine the prototype into a design that will meet Navy requirements. The company will prepare a Phase III development plan to transition the technology to Navy use.

PHASE III: The company will support the Navy in transitioning the data compression algorithm technology for Navy use on targeted ship-to-shore communication networks. The company will develop the data compression algorithm to increase voice and data transmission throughput, and will perform operational testing to evaluate effectiveness in an operationally relevant environment. The company will support the Navy in transitioning the data compression algorithm to its intended platform.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Compression algorithms that aid in the transmission of large amounts of data have both commercial and military benefits. Communication systems that are limited by the available spectrum or power output may benefit from this technology. Compression algorithms can mitigate the adverse effects on communications equipment with design constraints, such as portability.

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KEYWORDS: Increasing transmission throughput; data compression algorithm; digital communication network; dropped data packets; statistical compression techniques; lossless data compression

TPOC:	David Leeson
Phone:	(202)781-3673
Email:	david.leeson@navy.mil
2nd TPOC:	Pedro Frau
Phone:	(202)781-4342
Email:	pedro.frau@navy.mil

N151-048 TITLE: <u>Long Life, Highly Efficient Electrical Energy Storage for Sensor Systems</u>

TECHNOLOGY AREAS: Ground/Sea Vehicles

ACQUISITION PROGRAM: PMS450, VIRGINIA Class Program Office

OBJECTIVE: Develop a battery or other energy storage system that achieves long life and low power secondary (rechargeable) operation at low cost to provide power for wireless sensors in a shipboard environment.

DESCRIPTION: Wireless technology is being integrated into shipboard sensor systems to significantly reduce installation cost. Currently, sensor systems either pull power from the platform's main electrical bus, or else require their own battery. The application of shipboard wireless technology, however, is currently limited to those sensor systems with low data rate and low duty cycle requirements. The power demands of high data rate and high duty cycle sensor systems will quickly deplete the power in currently available batteries, which have limited cycle life and lower energy density than is required for small distributed sensor systems. For example, high density laptop, phone and automotive batteries have a finite number of charge-discharge cycles over a limited number of years (ref 1,2), while the best Lithium (Li)-ion batteries are limited to an energy density of ~800 Watt-hours per liter (Wh/L) (ref 3). To achieve density requirements, autonomous sensors have typically required use of a primary (i.e., non-rechargeable) battery in order to achieve sufficient runtime and size to be practical, which is not feasible in terms of accessibility and maintainability in a submarine environment.

To overcome this challenge, high density rechargeable storage (e.g. secondary batteries or other devices) are necessary which can support the sensor system operation and be sustained by intermittent power from an energy harvesting or other electrical system. This topic will complement an energy harvesting system for a sensor, as well as an advanced wireless sensing suite. An advanced, high density rechargeable device will allow the system to operate without power, thus reducing cost and increasing capability due to lower required maintenance (than when installed with conventional batteries) and decreased energy use. By being wireless and not requiring outside power, mission capability can be increased by allowing more utilization of sensing systems in more locations where before it was impractical.

This topic seeks to develop an innovative battery or other energy storage system technology that will enable high data rate and high duty cycle wireless sensor systems for shipboard applications to become feasible. The battery or energy storage system should demonstrate energy density and cycle ability at nominal rates. The performance characteristics of the device should be defined, and design configuration developed to analyze all possible failure mechanisms. Reliability should be estimated based on the performance of the electrical and mechanical subsystems. The technology proposed must be suitable for shipboard applications, given the safety requirements for shipboard energy storage. Included in the overall approach should be an attempt to minimize volatile and flammable electrolytes, as well as materials that have low thresholds for energetic release. An ionic approach (i.e., no metal) is preferable. Intrinsic safety should be emphasized to the greatest extent possible. In the case of damage, the technology will not release toxic, flammable or other hazardous materials. In the case of an overheating or thermal event in one cell, it is desirable that the energy released will not cause propagation of failure into a neighboring cell; validation of this must be able to be demonstrated by testing as defined in Navy Technical Manual S9310-AQ-SAF-010 for Batteries.

The requirements guidelines for the battery or energy storage system are:
• Voltage: 2 - 5 Volts
• Maximum instantaneous output power: 3 watts. Nominal output power: 100 miliwatts. Cell format: "D" cells or smaller is preferred, however if a suitable case can be made for other non-cylindrical geometries to ensure efficient packing density, they may be considered.
• Gravimetric Energy Density: >500Wh/kg
• Volumetric Energy Density: >1500Wh/L
• Rechargeable - maximum input power: 1 watt. Retains >60% of capacity after 300 full charge/discharge cycles.
• Must meet requirements for shipboard use (e.g. operate in a rugged environment)

PHASE I: The company will define and develop a concept for producing a rechargeable, long endurance storage device that meets the requirements as stated in the topic description. The company will demonstrate the feasibility of the concept in meeting Navy needs and will establish that the concept can be developed into a useful product for the Navy. Feasibility will be established by material testing and analytical modeling. The final concept design should demonstrate energy density and cycle ability at nominal rates.

PHASE II: Based on the results of Phase I, the small business will develop a full-scale prototype for installation into a wireless sensor system for evaluation. The prototype will be evaluated to determine its capability to meet the performance goals and Navy requirements for a rechargeable device with high density. The performance of the device will be demonstrated through prototype laboratory and shipboard testing over the required range of parameters including numerous deployment cycles. The full scale prototype will be evaluated for safety as requisite for allowing operation shipboard. Evaluation results will be used to refine the prototype into a design that will meet Navy requirements. The company will prepare a Phase III development plan to transition the technology to Navy use.

PHASE III: The company will be expected to support the Navy in transitioning the technology for Navy use. The company will develop a rechargeable device according to the Phase III development plan for evaluation to determine its effectiveness in an operationally relevant environment. Perform safety testing and fabricate any required safety containment or structure to enable qualification and long-term use. The company will support the Navy for test and validation to certify and qualify the battery for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Development and production of a long endurance, low power output, low cost device can be used by the private sector to make a number of potential commercial wireless sensor systems feasible without the use of primary batteries or tether to a constant power source.

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http://www.transportation.anl.gov/batteries/us_china_conference/docs/battery testing roundtable/Test_of_battery_tsinghua.pdf

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KEYWORDS: Secondary Ionic battery; energy density; cycle life; intrinsic safety; volumetric capacity; battery cycle efficiency

TPOC:	John Heinzel
Phone:	(215)897-1413
Email:	john.heinzel@navy.mil
2nd TPOC:	Frank Gulian
Phone:	(215)897-1957
Email:	franklin.gulian@navy.mil

N151-049 TITLE: Machine Learning Algorithm for Target Detection on the Coastal Battlefield and Reconnaissance (COBRA) System

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PMS495, Mine Warfare Program Office, Coastal Battlefield Reconnaissance and

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop innovative machine learning methods for improved minefield and obstacle detection and false alarm mitigation in aerial multi-spectral imagery that incorporate ongoing operator-provided decision information and algorithm parameter optimization.

DESCRIPTION: The Coastal Battlefield and Reconnaissance (COBRA) program (Ref 1) is interested in technologies that facilitate automated target recognition (ATR) capabilities in aerial multi-spectral images for previously unseen environments and target types. Targets of interest include minefields and obstacles in various land and marine environments. Typically, ATR algorithms are developed offline (post-mission) using previously acquired test data sets. These algorithms are based on supervised learning methods (Ref 2) that incorporate data from a limited set of test fields. When data is acquired in new environments, the algorithms often must be re-optimized to have good performance in that environment, as well as maintain performance in previously seen environments. The process for performing this offline re-optimization is often costly since it requires the efforts of expert analysts to assimilate data sets, determine target truth, analyze target features, train the ATR classifiers and evaluate performance.

There is a need for innovative methods that can 1) incorporate information from new data sets into the ATR system as they are acquired, and 2) re-optimize ATR algorithms quickly across all known environments, including those of newly acquired data. Online Machine Learning (OML) algorithms (Ref 3-5) can potentially be used to “learn” in the field based on operator-provided results without affecting prior performance. The information collected online can be used to refine the prediction hypothesis (classifier) used in the ATR algorithms. In addition, the information may provide input for automated methods of optimizing ATR performance across all known data sets.

The proposed effort will develop innovative OML algorithms for ATR that can incorporate human operator decisions to optimize probability of detection and probability of false alarm performance in new environments and for new target types. These algorithms will be integrated into mission and post-mission analysis systems in which operators review acquired images. The algorithms will be implemented as object-oriented C++ code for insertion into the operator systems. Development of the online learning algorithms must be combined with identification of how the operator will interact with them to provide updated decision information. Robust optimization of the ATR algorithms may be performed post-mission, which will require the development of separate software tools for processing historical data sets. The OML algorithms and optimization tools developed in this effort will reduce program costs by minimizing the time required for optimizing ATR algorithms to perform well in unseen operational environments.

PHASE I: The small business will develop and demonstrate proof-of-concept online machine learning algorithms against existing Government Furnished Information (GFI) multi-spectral image data sets. Demonstrate the feasibility of using the algorithms to perform online machine learning and to re-optimize ATR performance quickly as new data sets are introduced. Show how these algorithms will be used to improve ATR performance in previously unseen environments beyond the performance of the system optimized on previous data sets. Prepare a plan for incorporating operator decision information into the baseline ATR algorithms.

PHASE II: Further develop and optimize Phase I algorithms and tools and implement them in C++ as object oriented classes. Implement and demonstrate the capability for incorporating operator decision information into the ATR algorithms. Develop a prototype graphical user interface for operator interaction. Demonstrate performance across a broad set of GFI imagery. Performance will be validated with government-provided target truth. The Contractor will prepare a Phase III development plan to transition the technology to Navy use. It is probable that some work under the Phase II will become classified.

PHASE III: If Phase II is successful, the company will be expected to support the Navy in transitioning the technology for Navy use. The company will incorporate the machine learning algorithms and software tools to improve performance of the COBRA Block I and II systems. The company will also support updates to the COBRA Technical Data Package (TDP) to support the Navy in transitioning the design and technology into the COBRA Production baseline for future Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The technology developed here can be applied to numerous pattern recognition problems, including surveillance tasks, facial recognition, remote sensing, and Intelligence Preparation of the Operational Environment (IPOE).

REFERENCES:
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KEYWORDS: Online machine learning; global optimization; automated target detection; semi-supervised learning algorithms; Coastal Battlefield Reconnaissance and Analysis (COBRA); post mission analysis

TPOC: Andrew Blair
Phone: (850)234-4474
Email: andrew.blair@navy.mil
2nd TPOC: Dawn Klamser
Phone: (850)230-7148
Email: Dawn.Klamser@navy.mil

N151-050 TITLE: Wideband Acoustic Signature Capability for Next Generation Mobile Anti-Submarine Warfare (ASW) Training Target

TECHNOLOGY AREAS: Ground/Sea Vehicles

ACQUISITION PROGRAM: PMS404, Undersea Weapons Program Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a transducer system that will provide the wideband acoustic signature required for the next generation small diameter expendable mobile training target that will satisfy the training needs of all current and potential users.

DESCRIPTION: Anti-submarine warfare (ASW) training is significantly more effective when air, surface, and sub-surface platforms and their ASW sonar crews train in the operational environment in which they would locate enemy submarines. Training against live submarines is costly and most often not available. Mobile ASW training targets fill this critical training need. Naval forces need to be trained with new and sophisticated technologies that simulate real world conditions and scenarios to effectively counter future undersea threats. A next generation small diameter mobile ASW Training Target which emulates realistic threat signatures is in the development stage. It must encompass low cost, a relatively small size, maximum achievable bandwidth and source level. The transducer suite is the most significant challenge in developing this target. As transducer size decreases, particularly the diameter, it becomes considerably more difficult to achieve the bandwidth and source levels required to emulate such signatures. The goal of this SBIR is to achieve large bandwidth and source level via unique, innovative designs incorporating a small size transducer.

The current mobile target systems are of the 21 inch diameter heavyweight variety, such as the Mk30 Mod 1 target (ref 1). The Expendable Mobile Anti-Submarine Training Target (EMATT) does not provide the acoustic signature spectrum and level for the current requirement (ref 2). The EMATT diameter is 4.85 inches, which is a limiting factor for signature generation. The next generation target will be larger in diameter than the EMATT yet smaller than the heavyweight 21 inch, accommodating the latest transducer technology. The Navy's intent is to receive innovative technologies from the small business in order to provide the design, development and integration of a transducer system that would accommodate low cost virtues but provide the acoustic capabilities analogous of the heavyweight ASW target.

The small business should explore systems within the threshold maximum outside diameter (OD) of 12.75 inches and propose alternate smaller diameter versions with an objective of a suite to fit in a 6 inch OD target. A path to fit the proposed transducer system into a 4.875 inch diameter form factor is also of interest. The major areas of consideration are small diameter, low cost, maximum frequency cover, and maximum source level. The goal is the capability to replicate the threat signature performance of the mobile training target, Mk 30 Mod 1.

Current technology has advanced beyond the transducer types in use by the heavyweight ASW targets. Various known unique designs promise substantial improvement over the current device capabilities. Identifying or referencing such designs is intentionally omitted here to preclude appearance of a preferred candidate solution. Descriptions of underwater acoustic design and operational considerations are given in references 3 and 4. Consideration should be given to minimize the size and cost with the maximization of frequency coverage and source level.

PHASE I: The company shall define and develop concepts for a candidate wide band transducer system that provides the acoustic response over the low frequency and sonar band spectrum. The company shall determine the feasibility of the candidate transducer system to meet the topic description and shall provide design data and analysis to substantiate it. The company should consider how the candidate transducer system can be integrated into an advanced ASW mobile training target.

PHASE II: Based on the results of Phase I the company will develop a wide band transducer system prototype for evaluation. The prototype will be evaluated to determine its capability in meeting Navy requirements for a wideband transducer system. System performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters. Evaluation results will be used to refine the prototype into a design that will meet Navy requirements. The company will develop a Phase III development plan to transition the technology to Navy use.

PHASE III: If Phase II is successful, the company will be expected to support the Navy in transitioning the technology to its intended platform for Navy use. The company will develop a wideband transducer system for evaluation to determine its effectiveness in an operationally relevant environment. The company will support the Navy for test and validation to certify and quantify the system for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: An innovative design which provides a highly efficient, cost effective, minimum size transducer should find broad application with other users such as sonobuoys, underwater communications, other undersea mobile systems, and oceanographic systems.

REFERENCES:
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KEYWORDS: Mk 30 Target; ASW training target; broadband underwater transducer; compact underwater transducer; broadband active sonar; high-efficiency sonar transducer

TPOC: Robert Pendleton
Phone: (401)832-1691
Email: pendletonrl@npt.nuwc.navy.mil
2nd TPOC: Brian Cournoyer
Phone: (401)832-1370
Email: brian.cournoyer@navy.mil

N151-051 TITLE: Automated Analysis of Combat Systems Software

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PEO IWS 1.0, Integrated Combat Systems, AEGIS

OBJECTIVE: Develop an automated analysis tool for combat systems software system change request databases.

DESCRIPTION: Modern naval combat systems are continually being operated, upgraded, and tested at-sea and ashore. At any given time, there are many requests to de-bug, change, or update the underlying Computer Programs (CP). These requests are called Change Requests (CR) and are tracked in combat system databases. The CRs are reviewed and evaluated by a board of experts to determine the relative necessity and priority of implementing these changes. This process involves classifying the type of change, assigning a relative priority to the change, and determining the impact to other systems if the change is implemented. It requires experts from different engineering communities possessing various knowledge backgrounds to understand the complexity, priority, and need of each CR. After various reviews by the board, the resulting prioritized lists often reflect subjective rankings rather than an objective engineered recommendation to implement certain CPCRs [Ref 1].

The Navy needs a way to objectively prioritize CRs for implementation into the combat system. This topic seeks an automated tool to cull through hundreds of candidate engineering changes to recommend which should be selected to invest in and incorporate into revisions of the Aegis system. The current method is subjective and manpower-intensive. It is fraught with uncertainty and prone to improper classification and overlooking high priority needs. The Navy has been unsuccessful in finding a solution to review, classify, and prioritize the CRs in a combat system database. A tool is needed that will replace the engineering experts, and has the capability to determine the relative importance and priority of all the CRs found within a combat system’s database.

The Navy is interested in exploring the field of knowledge engineering management as a mechanism for the design of a decision tool. Using an artificial intelligence (IA) system which can learn to replicate the “expert panels” decisions of the past and then see if the IA software is “teachable” for the future would effectively automate the process and provide a knowledge database. Modern models, such as Model-based and Incremental Knowledge Engineering (MIKE) and heuristic classification, [Ref 2] are commercially available and could be considered for use in developing a tool for screening CRs to assign a relative rank for each. The tool will need to evaluate a number of disparate criteria, including (1) the estimated amount of code de-bugging work required to implement the CR, (2) the reduction in watchstander workload resulting from CR implementation, and (3) the mission area impact if the CR is not implemented.

PHASE I: The company will define and develop a concept for an automated analysis tool that meet the requirements stated in the topic description. The company will demonstrate the feasibility of the concept in meeting Navy needs and will establish that the concept can be developed into a useful product for the Navy. Feasibility will be established by testing and analytical modeling.

PHASE II: Based on the results of Phase I, the small business will develop a prototype analysis tool for evaluation. The prototype will be evaluated to determine its capability in meeting Navy requirements for the automated analysis tool. System performance will be demonstrated through prototype evaluation and modeling or analytical methods. Evaluation results will be used to refine the prototype into a design that will meet Navy requirements. The company will prepare a Phase III development plan to transition the technology to Navy use.

PHASE III: The company will be expected to support the Navy in transitioning the automated analysis tool technology for Navy use. The company will develop the automated analysis tool according to the Phase III development plan for evaluation to determine its effectiveness in an operationally relevant environment. The company will support the Navy for test and validation to certify and qualify the system for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Commercial software developers routinely test and upgrade their computer programs. How these companies determine which fixes to implement is normally proprietary information. However, a successful CR evaluation tool could be readily adopted in the commercial sector to prioritize fixes that have the greatest impact for their customers.

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KEYWORDS: Computer program change requests (CPCR); knowledge engineering management; watchstander workload; combat system database; Model-based and Incremental Knowledge Engineering (MIKE); heuristic classification

TPOC:	Fred Rischmiller
Phone:	(202)781-1407
Email:	Frederick.rischmille@navy.mil
2nd TPOC:	Eric Gilliam
Phone:	(202)781-4109
Email:	eric.gilliam@navy.mil

N151-052 TITLE: Temporary Crack Repairs for Aluminum Structures on Surface Ships

TECHNOLOGY AREAS: Ground/Sea Vehicles

ACQUISITION PROGRAM: SEA21, PMS400F Surface Combatant Program Office

OBJECTIVE: Develop a novel temporary repair solution for both sensitized and stress-cracked aluminum ship structures that arrests/retards crack growth, restores watertight boundaries, and which can be performed by the ship's force.

DESCRIPTION: There is a need for improved temporary repair technologies for United States (U.S.) Navy surface ships, available to the ship's force or shipyard maintenance for immediate application to cracks identified on aluminum structures. Currently, permanent repairs of cracked and sensitized aluminum in naval ship structures requires damaged material to be cut out. Replacement material is then welded back into the cutout shape. Permanent repair can be too costly and time-consuming for the limited repair times available, or if damage is identified during a deployment. In these cases, temporary repair methods are often used. Current ship-force temporary repairs are designed to keep the interior dry, but do not prevent additional crack growth. Improved temporary repair technology would ideally help minimize permanent repairs by preventing additional crack growth.

Cracking in aluminum marine structures is often a result of fatigue or weld defects (Reference 1). Additionally, several classes of U.S. Navy ships use marine aluminum alloys for structures that are susceptible to sensitization. Sensitization can lead to stress-corrosion cracking (Reference 2). Permanent repairs of a cracked aluminum structure are expensive, and replacement of sensitized aluminum is even more expensive due to the additional quality controls implemented in fabrication, welding and inspection of repairs (Reference 3).

Several temporary repair methods approved for use include fiberglass composite patches, polysulfide, doubler plates, or compression bolts. Each of the current methods has drawbacks that limit the utility as a repair option. Fiberglass composite patches are costly due to installation and non-recurring engineering costs for each application. The current fiberglass resins cannot be stored shipboard nor are they feasible for ship's force to apply properly. Polysulfide is usable by ship's force but only re-establishes the watertight boundary. Doubler plates come in two varieties - welded or adhesive bonded. Welding adds residual stress that can start new cracks around the new weld joint, and adhesive bonded plates can be applied by ship's force repair to reestablish water-tightness but does not arrest crack growth. Compression bolts have been proven effective when used on fatigue crack tips to prevent additional crack growth, but they cannot be implemented when the cracks end in non-planar areas and they do not restore watertightness.

Research is needed to develop a temporary repair technology that is deployable by ship's force, not limited by geometry, and that can provide structural support to prevent crack growth and provide a watertight boundary for marine aluminum structures. The solution needs to be compatible with aluminum from a corrosion perspective.

PHASE I: The company will define and develop a temporary repair concept for cracked aluminum structures. The company will demonstrate the feasibility of the repair concept for applications in both primary hull and deckhouse structures. The company will also establish that the repair concept can be developed into a useful solution for the Navy. Material testing and modeling will be used to establish feasibility.

PHASE II: Based on results of Phase I, the company will develop a prototype repair concept for cracked aluminum structures for evaluation. The prototype will be evaluated to determine its capability in meeting the performance goals and Navy requirements for suitability as a structural repair method. Performance will be demonstrated through prototype testing over parameters relevant to end use. Performance results will be used to refine the repair concept prototype into a documented repair procedure that will meet Navy requirements. The company will prepare a Phase III development plan to transition the technology to Navy use.

PHASE III: Based on results of Phase I and Phase III development plan, the company will refine the repair concept for evaluation. The repair concept will be evaluated to determine its capability in meeting the performance goals defined in Phase III development plan and the Navy requirements for suitability as a structural repair method. The company will assist the Navy in transitioning the repair procedure for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Aluminum cracking and sensitization likely affect other marine vessels and structures using 5XXX series aluminum. This technology may be applicable for use in repair of these commercial items. Repairs employing elements of epoxy-based polymers will likely have immediate benefit in commercial hull applications.

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KEYWORDS: Sensitization of aluminum structures; stress corrosion cracking of aluminum; structural repairs of ships; marine aluminum fatigue and stress cracking; crack growth prevention on ship structures; watertight repairs of aluminum structures while underway

TPOC:	John McGrorey
Phone:	(202)781-5382
Email:	john.mcgrorey@navy.mil
2nd TPOC:	Catherine Wong
Phone:	(301)227-4971
Email:	catherine.wong@navy.mil

N151-053 TITLE: Coastal Battlefield Reconnaissance and Analysis (COBRA) Multi-Spectral Illuminator

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PMS495, Mine Warfare Program Office, COBRA

OBJECTIVE: Develop a "Night Time" capability for Coastal Battlefield Reconnaissance and Analysis (COBRA) that will provide the necessary light source for the COBRA camera.

DESCRIPTION: The current COBRA sensor is only capable of daytime operation. The proposed effort will develop a light source which will allow for the use of multi-spectral imagers, such as those found in the COBRA system, during nighttime operations. To successfully get to this future system, the competing requirements of size, weight, power and thermal management will need to be overcome. This development effort will reduce costs for the COBRA program by continuing previous developmental efforts for an illumination source and by increasing availability to be used 24 hours a day which will reduce deployment time and overall operational costs.

Current electro-optic illuminators are single wavelength (band) sources that cannot illuminate the six band light spectrum required for the COBRA camera. Additionally, current single band illuminators that meet the derived size, weight, and power requirements for COBRA provide insufficient illumination power for the COBRA camera field of view. The innovation of the COBRA Multi-Spectral Illuminator will be to provide the broadband light that will provide sufficient illumination power for the COBRA camera to image mine lines and minefields at night.

The objective is to create a small form factor, light weight, low power, and medium repetition rate broadband illuminator that is robust enough to be integrated onto the Fire Scout MQ-8B (ref 1). Additionally, the illuminator would need to output the required light levels for a duration suitable for integration by the COBRA (ref 3) camera, a Charge Coupled Device (CCD) (ref 2), and with a relevant field of view. These competing requirements will need to be balanced to create an active light source. It will also need to match the solar illumination levels in each defined band (ref 4) for an equivalent of 5 Watts per square meter (W/m2), as measured on the ground with the sensor at 915 meters above ground level and a field of view of at least 2 by 2 degrees, across all bands.

Three illumination technologies– Red Green Blue/Infrared (RGB/IR) lasers, RGB/IR light emitting diodes, and small/lightweight strobe lighting, have been previously explored for potential multi-spectral illumination. However, none of these technologies are mature enough to meet the technical requirements for COBRA camera illumination without further technical development and innovation. However, any of these three technologies, as well as other approaches, could serve as the basis for meeting the objectives of this topic.

PHASE I: The small business will define and develop a concept for a COBRA Illuminator and assess the feasibility for COBRA insertion. The small business will demonstrate the feasibility of the COBRA Illuminator concept in meeting COBRA program needs, and will show that the concept can be developed into a useful product for the COBRA program capable of fitting within the Fire Scout size, weight and power constraints. Phase I awardees will be provided specific size, weight and power constraints for concept development.

PHASE II: Based on the results of Phase I, the small business will develop a COBRA Illuminator prototype for evaluation. The prototype will be evaluated in conjunction with the COBRA camera to determine whether it can meet COBRA requirements for Night Time Detection Performance. System performance will be demonstrated through prototype evaluation and ground test methods over the required range of landscapes and scenes. COBRA Illuminator evaluation results will be used to refine the prototype into a design that will meet the COBRA program requirements for Night Time Detection with the COBRA system and illuminator fitting within the Fire Scout size, weight and power constraints. The small business will prepare a Phase III development plan to transition the technology to Navy use.

PHASE III: If Phase II is successful, the company will provide support in transitioning the technology for Navy use. The small business will integrate and retrofit existing COBRA Systems with the COBRA Illuminator, according to the Phase III development plan, for evaluation to determine its effectiveness in an operationally relevant environment. The company will complete Flight Demonstration and Environmental Qualification for test and validation to certify and qualify the system for COBRA program use. The company will also support updates to the COBRA Technical Data Package (TDP) to support the Navy in transitioning the design and technology into the COBRA Production baseline for future Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: In addition to successfully transitioning multi-spectral illumination into the COBRA program, the technology can be multi-faceted for use in the private sector. Multi-spectral imaging capabilities and the associated illumination will be utilized to expand current terrestrial sensing to be operational 24 hours a day. The application includes farm and crop monitoring, geological mapping, terrestrial imaging, ocean sensing and research, as well as numerous law enforcement applications. Attention will be given to these multi-use applications as the program progresses to address potential commercial spin-off opportunities.

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KEYWORDS: Broad Band Illumination; Multi-Spectral Imaging (MSI); Coastal Battlefield Reconnaissance and Analysis (COBRA); Mine Countermeasures (MCM); Intelligence Surveillance and Reconnaissance (ISR); Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle (VTUAV) payload

TPOC:	Andrew Blair
Phone:	(850)234-4474
Email:	andrew.blair@navy.mil
2nd TPOC:	Dawn Klamser
Phone:	(850)230-7148
Email:	Dawn.Klamser@navy.mil

N151-054 TITLE: Threat Suitability Tactical Decision Aid for Anti-Submarine Warfare

TECHNOLOGY AREAS: Information Systems

ACQUISITION PROGRAM: PEO IWS 5, Undersea Warfare Systems

OBJECTIVE: Develop an innovative tactical decision aid (TDA) for Anti-Submarine Warfare (ASW) threat operations that evaluates the geospatial suitability requirements of an area of interest.

DESCRIPTION: The amount of information available to accomplish the Anti-Submarine Warfare (ASW) mission has been increasing significantly in the last 10 years, and there is a broad spectrum of information available for analysis to help in solving the ASW problem. When an ASW threat executes a mission against U.S. Navy forces, the opposing force (OPFOR) commander must consider the environment, tactical situation, ownship capabilities and mission objectives to develop a course of action. This process will involve trade-offs where one factor, such as required proximity to a high value target, is offset by another factor such as increased detection vulnerability.

The technology to explore and evaluate these types of trade-offs has been developed for wide ranging applications, to include location recommendation systems for business sites [ref 1], evaluation of animal habits [ref 2], and urban land use planning [ref 4]. Perhaps the most relevant to ASW application is to identify potential crime areas [ref 3] based on suitability for criminal intent. These technologies represent the state-of-the-art in geospatial suitability analysis. The basis of this project is to use whatever information technology is used today for predicting events – such as in high crime areas (among others) by melding historical and in situ data. We seek to adapt them and develop innovative new technologies applicable to ASW.

By understanding how information affects OPFOR mission planning trade-off and by developing possible OPFOR courses of action (often termed red teaming), insights in to the geospatial suitability for OPFOR operations can be developed in order to provide enhanced situational awareness and more effective ASW mission planning. For example, this technology could provide the understanding of what corridors are suitable for a covert transit, or determine where high speeds can be maintained for expedient transits, and determine a good location to pump waste. U.S. Navy ASW personnel have gained the ability to assess potential threat trade-offs through years of experience. Their expertise will be used to define trade-offs in the TDA and to assist the operators by providing rapid and comprehensive initial assessment of possible threat locations, enabling the operator to reduce the time to develop mission plans and maintain a higher level of situational awareness.

The desired TDA technologies will provide knowledge representations, geospatial models, and reasoning algorithms that capture this experience and apply it to the current tactical picture in order to understand the suitability of threat operations occurring across an area of interest. The TDA is required to operate with current tactical, environmental and operational data sources, and provide results in a concise format within the ASW mission systems. The small businesses will need to establish a baseline of current performance in particular scenarios provided by the Government to be used for comparison purposes. This understanding will provide ASW commanders with a sound expectation of where OPFOR assets may be operating, enhancing their ability to locate and counter those threats.

PHASE I: The company will define and develop a concept for an innovative Tactical Decision Aid that meets the requirements stated in the topic description. The company will demonstrate the feasibility of the concept in meeting Navy needs and will establish that the concept can be developed into a useful product for the Navy. Testing and analytical modeling will establish feasibility based upon performance in particular scenarios.

PHASE II: Based on the results of Phase I, the company will develop a Tactical Decision Aid prototype for evaluation. The prototype will be evaluated to determine its capability in meeting the performance goals and Navy requirements for an innovative Tactical Decision Aid. System performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters. Evaluation results will be used to refine the prototype into an initial design that will meet Navy requirements. The company will prepare a Phase III development plan to transition the technology to Navy use.

PHASE III: The company will support the Navy in transitioning the technology for Navy use. The company will develop an innovative Tactical Decision Aid according to the Phase III development plan for evaluation to determine its effectiveness in an operationally relevant environment. The company will support the Navy for test and validation to certify and qualify the system for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The resulting enhanced suitability analysis capability is widely applicable in commercial applications. The concept of suitability analysis has been widely used in other fields, including urban land use impact and planning, retail site selection, crime prevention, and agriculture site or crop recommendation. This technology would be most applicable for counter terrorism to predict likely targets or training areas and for criminal interdiction predicting high crime areas, smuggling routes or emerging criminal activities.

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KEYWORDS: Global information system; threat suitability evaluation; geospatial modeling; multi-criteria decision making; ASW; ASW threat analysis

TPOC: J.P. Feuillet
Phone: (202)781-4470
Email: jean.feuillet@navy.mil
2nd TPOC: Abel Ortiz
Phone: (202)781-0530
Email: abel.b.ortiz@navy.mil

N151-055 TITLE: Multi-ship Sonar Bistatic Automatic Active Localization

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PEO IWS 5, Undersea Warfare Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop Multi-ship Sonar Bistatic Automatic Active Processing and Localization Coordination that meets system requirements.

DESCRIPTION: The Navy needs improved performance when multiple surface ships are transmitting simultaneously in a strike group and when submarines utilize active sonar capability in coordinated operations. Bistatic reception and processing of active transmissions provides the capability for a single receiver to increase the amount of opportunities it has to exploit active acoustic transmissions, allows for stealthy receivers to process active transmissions without giving away its location, and decreases interference from many ships transmitting simultaneously. In order to achieve these bistatic reception benefits, each receiver needs some information about the remote source. A solution to the source information exchange problem within a communications implementation framework will allow for a cost-effective implementation approach to take advantage of the strike group and submarine active multi-ship coordination benefits.

Successful application of multi-ship bistatic active sonar processing requires information exchange or inference of certain source transmitter parameters to achieve optimal processing and localization accuracy [ref 1]. To utilize an active bistatic receiver successfully, the receiver requires information from or about the source platform including location, timing, and transmit types. The successful offeror will determine the optimal information to either transmit to or estimate on the bistatic receiver to minimize processing losses and to achieve weapons-quality localization solutions. The optimal information exchange will focus on acoustic warfare scenarios of interest for a source platform (surface ship mid- frequency sonar transmitters) and two receivers (surface ship and submarine mid-frequency active sonar receivers).

In order to process an active sonar transmission from a non-collocated source, a receiver must utilize or estimate the type of waveform transmitted; the source location, course, and speed; transmission time; and source and receiver time synchronization. A lack of knowledge in each of these areas can result in processing losses (lack of waveform information and matched filter), processing delays (to estimate waveform information), source location course and speed errors (localization errors), transmission time (localization error), and source and receiver time synchronization (localization error). The sensitivity of the localization error to these various parameters can be estimated [refs 1, 2]. The communications between source and receiver may be via high quality satellite communications; via limited-bandwidth satellite or acoustic communications; or via little or no communications. Limited bandwidth communications may impact the localization errors when parameters are transmitted with limited precision. No communications between source and receiver may increase the localization error due to errors in parameter estimation as well as an increase in non-recurring engineering costs to develop estimation algorithms. Utilizing example mid-frequency surface ship and submarine bistatic localization scenarios, a trade space study will indicate which parameters are most important to transmit or estimate, with what precision, and with what localization estimation approaches to achieve the minimum amount of transmitted information to achieve high levels of bistatic active processing and localization performance.

PHASE I: The company will develop a concept for a Multi-ship Bistatic Automatic capability that meets the requirements as stated in the topic description. This concept is based on an algorithm that will be added to the existing active monostatic processing capability. The company will demonstrate the feasibility of the concept in meeting Navy needs and will establish that the concept can be developed into a useful product for the Navy. Testing and analytical modeling will establish feasibility.

PHASE II: Based on the results of Phase I, the company will develop a prototype for evaluation. The software prototype will be evaluated to determine its capability in meeting performance goals and Navy requirements for the Multi-ship Bistatic Automatic capability. System performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters including numerous different operational scenarios. Evaluation results will be used to refine the prototype into an algorithm/software design that will meet Navy requirements. The company will prepare a Phase III development plan to transition the technology to Navy use.

PHASE III: The company will support the Navy in transitioning the technology for Navy use. The company will develop a Multi-ship Bistatic Automatic capability according to the Phase III development plan to determine its effectiveness in an operationally relevant environment. The company will support the Navy for test and validation to certify and qualify the system for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Within the commercial sector, there is a need to detect and localize objects on the ocean bottom such as toxic waste containers or shipwrecks. This bistatic capability would support searches by surface vehicles.

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KEYWORDS: Active bistatic sonar; non-collocated source; bistatic receiver; localization error for sonar transmission; limited bandwidth communications; estimation algorithms

TPOC:	Meg Stout
Phone:	(202)781-4233
Email:	meg.stout@navy.mil
2nd TPOC:	Dennis Ling
Phone:	(202)781-2179
Email:	dennis.ling@navy.mil

N151-056 TITLE: Prognostic Monitoring and Condition Reporting for Remote Multi-Mission Vehicle (RMMV) Subsystems

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PMS 403, Remote Minehunting System (RMS) Program Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a system for the Remote Multi-Mission Vehicle (RMMV) to monitor and record diagnostic data on the health of vehicle subsystem components for real-time mission decisions and post-mission analysis and targeted maintenance.

DESCRIPTION: The Navy needs a system consisting of sensors that monitors and records the health of RMMV subsystem components for post-mission analysis and that, additionally, analyzes the state of key components and reports critical information back to the operator in real-time to support decisions on mission continuation. Such a system will reduce the labor required in support of the RMMV by reducing unnecessary preventive maintenance and by identifying corrective maintenance in a timely manner, thereby increasing availability.

Unmanned sea vehicles operate in a constantly changing and corrosive environment which can contribute to accelerated failures of key components. Maintenance, preparation, launch and recovery of such vehicles is time-consuming and costly. Because these vehicles are unmanned, maintenance or faults typically cannot be fixed until they are recovered. Therefore, it is desirable to maximize the reliability and availability of these assets when they are on a mission. The ability to predict the remaining useful life of critical system components will allow targeted maintenance to be scheduled and performed, thus increasing vehicle availability and decreasing operating costs. In some instances, mission success may require these systems to continue executing with degraded performance due to a known fault. Developing methodologies for managing these failures and making educated decisions to optimize performance would increase the probability of continued operation. Additionally, maintenance would be planned and any required parts can be procured prior to vehicle recovery, reducing the mean time to repair.

The RMMV, an unmanned, remotely operated, diesel-powered semi-submersible vehicle, is deployed from Littoral Combat Ships to perform minehunting missions. The RMMV is capable of real-time communication back to its host platform (ref 1), and, conversely, an operator on the host platform can communicate commands back to the RMMV. Vehicle subsystems include self-contained control, propulsion, power, and navigation features (ref 1). The Navy has procured ten RMMVs of the current design, and there are plans to competitively award and fund the development and procurement of a next generation RMMV.

In general, the state-of-the-art of component condition health monitoring sensors and routine data recording is fairly mature (ref 2, 3); however, the process of automated gathering, analysis, and reporting of event data provides significant opportunity for innovation (ref 2). Condition Based Maintenance (CBM) approaches have been used for industrial machine applications (ref 2) and in the aerospace industry (ref 4), but are seldom used for unmanned maritime vehicles.

This topic has two requirements. In both cases, the effort will require working closely with the contractor that builds and provides the RMMV to the Navy to develop a plan for prognostic monitoring and condition reporting. Both also require that the data gathering and reporting technology integrate as much as possible with the RMMV software and communication capabilities. The government encourages offerors to make as much use as possible of previously developed technology, including sensors. Key innovations are likely to occur in the data analysis and operator alert functions. The government also encourages designs that minimize demands on size, weight, and power (SWaP) requirements. Instead of just sensing failures, prognostics allow the prediction of failures based on actual performance data collected and allow the Navy to take action before the failure and potential loss of an RMMV.

First, the transition target of the prognostic monitoring and condition reporting technology will be the next generation RMMV. The most cost-effective and efficient design and implementation of such a system should occur during the design and development of the vehicle itself, rather than as a retrofit, once the vehicle is developed. A subtask of the work will include a review of existing O-level maintenance for the current set of RMMVs and identification of maintenance actions that apply to a specific subsystem monitoring metric for recording prognosis data.

As RMMVs return to depots for refurbishment and restoration, the technology can be introduced to increase performance or reliability. A demonstration of the technology would not be for all vehicle subsystems, due to the challenges and costs of retrofitting. A portion of the monitoring system would be demonstrated, based on the most cost-effective choice. For example, the demonstration could apply to the control surface hydraulic actuators. The current RMMV has a position sensor located at the control surface actuator. This data along with commanded position are recorded to a log and can be accessed. The demonstration would be two-fold. The first would be to record the data for post-mission analysis. The second would be real-time analysis of the data and providing an alert to the operator on discrepancies between actual and commanded control surface position (e.g., position errors and response time). A yellow alert would signal degradation of performance to support an operators' decision to adjust commands to the vehicle with a view toward completing the mission at less than optimal performance. A red alert would support an operator's decision on whether or not to abort the mission. Inquiries have not turned up any commercially available sensors that diagnose and predict actuator health, so offerors may also assess the feasibility of developing such a sensor to provide additional data. For the current RMMV, data is available for items such as vehicle hydraulic pressure and vehicle spatial awareness (speed, depth, etc.). The demonstration for the current RMMV would not necessarily incorporate this data.

PHASE I: The company will define and develop a concept for prognostic monitoring and condition reporting for RMMV subsystems that meets the objectives as stated in the topic description. The company will show the feasibility of the concept in meeting Navy needs and will establish that the concept can be developed into a useful product for the Navy both for the current RMMV and for the planned upgrade. The company will review current O-level maintenance activities and determine the types that can be addressed via prognostic monitoring and condition monitoring and will provide supporting evidence to substantiate. The company will develop a plan for prognostic monitoring and condition reporting in conjunction with the next generation RMMV Low Rate Initial Production (LRIP) prime contractor. Material testing and analytical modeling, in a laboratory and/or on an actual unmanned vehicle, will establish feasibility.

PHASE II: Based on the results of Phase I, the company will develop a limited prototype for evaluation on the current RMMV, and develop and validate a full system design for the next increment of RMMVs. The demonstration of the limited prototype will be planned for the current RMMV control surface hydraulic actuators through a stand-alone implementation. The prototype will be evaluated to determine its capability in meeting the performance goals and Navy requirements for the prognostic monitoring and condition reporting system. Performance will be demonstrated through prototype evaluation and modeling or analytical methods. The validation of the full system design for the next increment of RMMV will be achieved through modeling and analytic methods, incorporating, where possible, the results of testing on equivalent subsystem components. In both cases, the company will use the results to refine the prototype into al design that will meet Navy requirements. The company will prepare a Phase III development plan to transition the technology to Navy use.

PHASE III: The company will support the Navy in transitioning the technologies into the applicable RMMVs. The company will support the Navy for test and validation to certify and qualify the system for Navy use. The company must work closely with the company that supplies RMMVs to the Navy.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The potential for commercial application and dual use are extensive. The use of unmanned maritime vehicles is expected to increase in industrial applications, such as oil exploration, oceanographic research, and rescue and recovery operations after disasters such as airplane crashes and other missions that would be hazardous for humans (e.g., nuclear disasters). The objectives that drive the development of the technology for military use are essentially the same for these other application areas.

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KEYWORDS: Unmanned maritime vehicles; system prognostic health monitoring; actuators; condition-based maintenance; system failure management; unmanned vehicle operator decision support

TPOC: Shreyansh Shah
Phone: (215)897-1261
Email: shreyansh.shah@navy.mil
2nd TPOC: James Hayes
Phone: (850)230-7590
Email: james.e.hayes1@navy.mil

N151-057 TITLE: Direct Band-Pass Analog-to-Digital Conversion

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PEO IWS 2, Above Water Sensors

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop direct band-pass analog-to-digital conversion capability for Navy rotating air surveillance radar systems to improve performance capability and reduce costs.

DESCRIPTION: The U.S. Navy is seeking research and development in band-pass sampled digital downconversion technologies for use with rotating air surveillance radar systems. Current radar systems designed in the 1990’s utilize two or three analog frequency downconversions and other signal processing operations prior to the conversion to digital inphase signal (I) and quadrature phase signal (Q) data. With multiple mixers, filters, and local oscillators, these systems have variable performance over time requiring manual adjustments to maintain optimum performance. As these systems age and require technical refreshing (tech refresh), an opportunity to simplify the system and reduce the cost of the tech refresh becomes available. A tech refresh for radar systems covering all below-deck electronics is actively being pursued. Operational availability for the system is well below the Navy benchmark and maintenance costs are increasing due to parts obsolescence.

According to James Alter and Jeffrey Coleman at the Naval Research Laboratory, "…band-pass sampling is a powerful tool that allows a relatively high frequency signal to be sampled by a relatively low-performance digitizer, which can result in considerable cost savings" (Ref. 1). If the band-pass sampling downconversion process is successfully demonstrated, then significant cost savings could be realized by a large reduction in required parts.

Communications systems are using this technique on multiple channels; however, no examples of this approach are currently available for an 850-950 Megahertz (MHz) radar system (Ref. 2). To successfully demonstrate the technology in this frequency range, a pulse-Doppler radar system with pulse compression is required.

The cost and performance is a major factor of a band-pass sampling approach that can be achieved by developing band-pass sampling, direct analog-to-digital conversion for the 850-950 MHz band for a pulse-Doppler radar system with pulse compression. This approach must support 90- 1 MHz bands of nonlinear frequency-modulated signals that yield a 1.5 microsecond (µs) compressed pulse from a 32 µs transmitted pulse. It is anticipated that the new system will have fewer parts. As a result, the new system should have both reduced maintenance costs and more cost-effective tech refreshes.

This effort requires an assessment of the feasibility of a receiver that can take in synthesized radio frequency (RF) radar return signals and output baseband I and Q in real-time with a demonstrated noise figure of less than 3.5 decibels (dB).

PHASE I: The company will define and develop a concept for a Band-pass Sampled, Digital Down conversion System that meets the requirements as stated in the topic description. The company will demonstrate the feasibility of the concept in meeting Navy needs and will establish that the concept can be developed into a useful product for the Navy. Material testing and analytical modeling will establish feasibility. The concept development effort should assess the importance of several factors, such as sampling rate, guard band size, and non-minimum sampling rates (Ref. 3). Evidence of design optimization and of these parameters as well as a comparison between model predictions and measured performance are required.

PHASE II: Based on the results of Phase I, the company will develop a prototype system for evaluation. The prototype will be evaluated to determine its capability in meeting performance goals and Navy requirements for the Band-pass Sampled, Digital Downconversion System. System performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters including numerous deployment cycles. Evaluation results will be used to refine the prototype into a design that will meet Navy requirements. The system should include filtering as required to reduce potential alias input. Documentation should include analysis comparing sampling rates, analog downconversion, noise figure, calculation of data throughput and recommendations for data handling/reduction. The company will prepare a Phase III development plan to transition the technology to Navy use.

PHASE III: The company will support the Navy in transitioning the technology for Navy use. The company will develop a Band-pass Sampled, Digital Downconversion System according to the Phase III development plan for evaluation to determine its effectiveness in an operationally relevant environment. The company will support the Navy for test and validation to certify and qualify the system for Navy use and transition the downconversion system to its intended platform.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Direct digital downconversion has application to the commercial radar market as well as additional military applications. The proliferation of small solid-state radars for remote sensing and navigation benefits from cost-saving digital technologies that drive affordability and consequently expand the market even further. The commercial market is typically quick to adopt technology that enhances performance while controlling cost. The technology developed under this effort will facilitate a shift from expensive RF analog receiver circuitry to receivers based on commercial microprocessor technology. Even complex commercial radars such as weather radar can benefit from this technology, as digital processing is inherently scalable, allowing radars of various size and complexity to achieve improved performance at reduced cost.

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2. Tseng, Ching-Hsiang, Chou, Sun-Chung. "Direct Downcoversion of Multiple RF signals Using Bandpass Sampling." IEEE Paper, 0-7803-7802, April, 2003.

3. Vaughan, Rodney, Scott, Neil, White, Rod. "The Theory of Bandpass Sampling." IEEE Transactions on Signal Processing, VOL. 39, NO. 9, September 1991: p 1973.

KEYWORDS: band-pass sampling; direct RF conversion; radar band-pass sampling; digital receiver design; digital signal processing; band-pass sampling coherent detection

TPOC:	John Stewart
Phone:	(812)854-3981
Email:	john.s.stewart@navy.mil
2nd TPOC:	Lawrence Dressman
Phone:	(812)854-4804
Email:	lawrence.dressman@navy.mil

N151-058 TITLE: Vertical Take Off and Landing Tactical Unmanned Aerial Vehicle (VTUAV) Passive Acoustic Sensing and Magnetic Anomaly Detection for Anti-Submarine Warfare (ASW)

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PMS 420, Mission Package Integration, Antisubmarine Warfare Mission Package

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an effective, flexible, and affordable submarine detection system consisting of acoustic sensing and a Magnetic Anomaly Detector (MAD) capability for a Vertical Take Off and Landing Tactical Unmanned Aerial Vehicle (VTUAV) to be used by any ship capable of launching and recovering a VTUAV (e.g., Fire Scout or equivalent capabilities).

DESCRIPTION: The current approach to air platform submarine detection is deployment of dipping sonars from MH-60 helicopters, full size sonobuoys (ref 2, 3) deployed from MH-60 helicopters and land-based P-3 aircraft, and Magnetic Anomaly Detectors (MAD) (ref 1) on fixed wing aircraft and helicopters (ref 1). While effective, these approaches are labor intensive, consume large amounts of fuel, and are costly. In addition, platforms such as the Littoral Combat Ships (LCS) that carry only one ASW-equipped helicopter have a less than optimal ASW capability. The Navy has identified a need for an Ultra-lightweight Airborne Deployment/Retrieval Sensor acoustic sensor capability in a "podded" system. This system can then be installed and removed rapidly on an MQ-8C Fire Scout Vertical Takeoff Unmanned Air Vehicle (VTUAV) to provide an adjunct ASW capability for the MH-60R. The proposed system will provide a low cost, lightweight, unmanned capability to complement current helicopter ASW operations.

This topic seeks a compact, affordable, energy efficient, acoustic sensing capability for a Fire Scout, or similar VTUAV. In addition, the VTUAV will use a Magnetic Anomaly Detector to complement the acoustic search for submarines. The desired system will increase the affordability of anti-submarine searches by lowering overall cost that currently requires a helicopter such as the MH-60. In addition, an Unmanned Aerial Vehicle (UAV) does not require an on-board crew. The proposed system should be usable by any ship capable of launching and recovering a VTUAV. The system would employ the VTUAV to perform acoustic sensing ahead of the host ship. The sensing could be "stand alone" or as part of a bi-static system, with the active source on the host ship or on a different platform. The system could employ a tethered approach for sensor deployment and retrieval or a traditional air launch deployment or combination. Littoral Combat Ships (LCS) have particular platforms of interest, though the VTUAV capability would not be restricted to a LCS.

The technologies for ASW acoustic sensing and magnetic anomaly detection are mature. Offerors are encouraged to consider using or adapting existing sensing and deployment technologies as much as possible. The innovation described in this topic requires several considerations. One is the design, development, and integration into the VTUAV of a compact, reliable, affordable system. A second includes launch and/or retrieval of acoustic capability. A third is designing to the Size, Weight and Power (SWaP) limitations of a VTAUV (SWaP requirements will be provided in a SITIS document). A fourth is minimizing the effects of noise from the VTAUV. A fifth is the fusion of acoustic and magnetic field data. In addition, the fused data must interface with the VTAUV's data communication and vehicle control system on the host ship.

PHASE I: The Company will define and develop a concept for VTUAV mobile acoustic sensor(s) and MAD capability that meet the objectives as stated in the topic description. The company will demonstrate the feasibility of the concept in meeting Navy needs and will establish that the concept can be developed into a useful system for the Navy. Feasibility will be established by analytical modeling.

PHASE II: Based on the results of Phase I, the small business will develop a prototype for evaluation. The prototype will be evaluated to determine its capability in meeting performance goals and Navy requirements. System performance will be demonstrated through prototype evaluation and modeling over the required range of parameters including numerous deployment cycles. Evaluation results will be used to refine the prototype into an initial design that will meet Navy requirements. The company will prepare a Phase III development plan to transition the technology to Navy use.

PHASE III: Based on the results of Phase II, demonstration in a realistic environment is planned. The company will support the Navy in transitioning the technology for Navy use. The company will develop the submarine detection system according to the Phase III development plan, for evaluation to determine its effectiveness in an operationally relevant environment. The company will support the Navy for test and validation to certify and qualify the system for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology will be useful in commercial underwater applications, to include the fields of oceanography and undersea search and recovery.

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3. Hewish, Mark, "Mini ballistic sonobuoys are developed for small-scale platforms," Jane's Information Group, International Defense Review, 2000.

KEYWORDS: Anti-submarine warfare; dipping sonar; Unmanned Aerial Vehicle; passive acoustics; magnetic anomaly detection of submarines; magnetometer for submarine detection

TPOC: Robert Brousseau
Phone: (401)832-8579
Email: robert.m.brousseau1@navy.mil
2nd TPOC: Paul Davis
Phone: (301)342-2115
Email: paul.h.davis@navy.mil

N151-059 TITLE: Digital Direction Finding (DF) System for the Next Generation Submarine Electronic Warfare (EW)

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PMS-435, Submarine Imaging and EW Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a new Submarine Imaging Mast Direction Finding (DF) capability for the Next Generation Submarine Electronic Warfare (EW) System.

DESCRIPTION: All Combatant Commands (COCOMs) have identified EW and Intelligence, Surveillance, and Reconnaissance (ISR) improvements, to support Force Application and Battlespace Awareness, as one of their highest priorities (ref 4,5). For submarines to meet the future COCOM ISR requirements they will need to improve the Direction Finding (DF) capability in the imaging mast. The proposed solutions to improve submarine DF must conform to open standards and approaches in the hardware and software design that shall readily support technological and functional advancement of the systems capabilities. DF is critical to improved situational awareness, ISR mission effectiveness, and overall ship safe operations particularly in the littoral operating regions.

The Next Generation Submarine EW system requires a DF capability that will be included in all future systems. This DF system will need to use common RF components, data pathways, and common processing capabilities to be included in the next generation architecture. It will need to be modular, scalable and fit into the digital framework, and current and future submarine mast configurations. The current DF system for Virginia Class submarines has six spiral DF horns that feed into a task tuned filtered bank (500 MHz instantaneous bandwidth) that provides an Intermediate Frequency that is converted to video via a set of SDLVA's. Each of these six video lines are available inboard for DF processing. Unfortunately, this current design severely limits the DF capability across the broad spectrum of radar emission operating today.

Current Submarine DF capabilities are closely coupled with the radar wideband components in a stove-piped architecture. The current architecture does not allow for cost effective improvements in system performance and the introduction of new capabilities without significant impact to the existing system. Another limitation of the current configuration is that RF information (for the DF antennas) is turned to video in the mast and therefore only video (amplitude) processing can be performed with the below decks equipment (ref 1).

The Next Generation Submarine EW system will need to provide Direction Finding applications and solutions using available data from the existing DF arrays. This data will be defined through the interface layer of the new architecture, allowing algorithms in the processing layer to be developed for increased accuracy and capability.

The challenge is to improve direction finding in the constrained environment of submarine apertures and the RF environment. The use of digital data is preferred but the space constraint for turning the DF spiral RF into digital data is a confined space outboard of 3" x 3" x 10". It is preferred that DF improvements are predominately software based solutions but hardware and software solutions will be entertained. The small business will have to work closely with the government to ensure that the proposed solutions are feasible in the current (and future) submarine mast constraints (extremely small volumes and very thick radomes) (ref 2,3).

PHASE I: The company will define and develop concepts for a submarine imaging mast DF capability that meet the requirements as stated in the topic description. The company will demonstrate the feasibility of the concept in meeting Navy needs and will establish that the concept can be developed into a useful product for the Navy. Feasibility will be established by analytical modeling.

PHASE II: Based on the results of Phase I, the company will develop a DF prototype for evaluation. The prototype will be evaluated to determine its capability in meeting performance goals and Navy requirements for a Next Generation EW Digital DF for submarines. System performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters including numerous deployment cycles. Evaluation results will be used to refine the prototype into a design that will meet Navy requirements. The company will prepare a Phase III development plan that will provide requirements to transition the technology for Navy use.

PHASE III: If Phase II is successful, the company will support the Navy in transitioning the technology for Navy use. The company will develop a Next Generation EW Digital DF for submarines for evaluation to determine its effectiveness in an operationally relevant environment. The company will support the Navy for test and validation to certify and qualify the system for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Government commercialization will be applicable across all submarine EW platforms. Modular DF techniques should be applicable to other Navy collection platforms (Triton, Firescout, EP-3, etc.).

Commercial applicability could be utilized in other agencies and potentially in the TELCOM industry for finding and localizing offending RF emissions.

REFERENCES:
1. Wiley, R. The Analysis of Radar Signals, 2nd ed. London, U.K.; Artech House Press, 1993.

2. Stephen V. Schell and William A. Gardner, “High Resolution Direction Finding,” Handbook of Statistics, Vol. 10, copyright 1993 Elsevier Science Publishers B.V.

3. Joshua Radcliffe, Dr. Krishna Pasala, “Radar Direction-Finding Technique Using Spiral Antennas,” AFRL-SN-WP-TP-2006-119. Retrieved from: http://www.dtic.mil/dtic/tr/fulltext/u2/a456424.pdf

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5. Dove, Rita. "Lady Freedom Among Us." The Electronic Text Center. Ed. David Seaman. 1998. Alderman Lib., U of Virginia. 19 June 1998.

KEYWORDS: Electronic support measures; Solid State Radars; direction finding algorithms; low peak power radars; Direction Finding Techniques; situational awareness

TPOC:	Steven Henry
Phone:	(401)832-7849
Email:	steven.w.henry1@navy.mil
2nd TPOC:	Jeffrey Carvalho
Phone:	(401)832-3527
Email:	jeffrey.carvalho@navy.mil

N151-060 TITLE: Power Technologies for Navy Conventional Ammunition Fuzes

TECHNOLOGY AREAS: Weapons

ACQUISITION PROGRAM: PEO IWS 3, Surface Ship Weapons

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OBJECTIVE: Develop a Reserve Power Solution for Navy Conventional Ammunition Fuzes that meets current and future Naval ammunition fuzing requirements.

DESCRIPTION: The primary fuzes for the Navy's 5" suite of ammunition, the MK 437 Multi-Option Fuze (MOFN) and the MK 419 MOD 1 Multi-Function Fuze (MFF), currently face obsolescence and sourcing issues with their reserve batteries. These reserve batteries are liquid based. The cathode material for the MOFN battery is obsolete and the MFF battery is sourced from overseas (Germany). The technological obsolescence and strategic sourcing issues of the fuzes' batteries puts the Navy's ability to arm its ships with modern, reliable, and precise Naval Gun Weapon Systems at risk. Given these shortcomings, this presents an opportunity to acquire an advanced reserve battery with the technology to support both current and future Naval ammunition fuzing requirements. Thermal batteries present an interesting solution given their inherent environmentally and electrically safe design, long shelf life, and zero maintenance. A new battery is required to sustain production of the Navy's suite of 5" high explosive ammunition. Thermal batteries are a promising technology for potential fuze power. Thermal batteries have been extensively developed in the United States and represent a stronger industrial base than a liquid reserve battery alternative (ref 1). While the thermal battery technology presents many advantages as a reserve battery, there are technological challenges impeding their application in Navy 5" electrical fuzing applications.

Reserve thermal batteries are a single use, high temperature, galvanic primary cell battery (ref 2). These batteries have been demonstrated to be environmentally safe and have a long shelf life which is ideal for military purposes (ref 1). Thermal battery composition allows it to withstand the severe environment of Navy gun ammunition, particularly acceleration, shock, vibration, and spin. They are reliable, safe, provide instantaneous activation, do not require maintenance, have chemicals which are inert until activated, and are designed to facilitate power or capacity improvements. The high conductivity of the electrolyte at high temperatures allows the battery to be discharged at high rates. Thermal battery applications and characteristics allow a design to meet specific electrical and environmental parameters (ref 3). Thermal batteries present a favorable solution given their inherent environmentally and electrically safe design, long shelf life, and zero maintenance.

Thermal batteries have a rise time that is directly proportional to their size while their run time is dependent on maintaining elevated temperatures. For Navy fuzing applications, this presents conflicting requirements as the reserve battery is required to rise to operating voltage very quickly and precisely while providing power for the relatively long time of flight. As a result, a large battery that might provide for the flight time would fail the rise time and volume allocation requirement. However, a smaller battery might address the rise time and volume allocation requirement but fail the flight time requirement. Currently, thermal batteries with a volume of 15-20 cubic centimeters cannot be designed to provide electrical power longer than around 50 seconds.

Naval 5" conventional ammunition fuze applications require batteries that can withstand setback launch forces and spin rates. Battery volume must also meet set requirements for fuze applications. The electrical requirements must meet current standards for nominal voltage, current draw, and run, and rise times. Specific innovations in both thermal battery heat management and scalable packaging efficiency to improve performance are required to meet these needs (ref 4). Based on current ammunition fuze electrical requirements, a nominal voltage of about 12V, current draw of up to 325 mA, runtime of 200 seconds, and a rise time of less than 10ms with a standard deviation of about 1ms is expected. This reserve power solution will include scalable thermal battery packaging meeting requirements of Navy 5" conventional fuzing.

PHASE I: The company will identify and design a concept for a Reserve Power Solution for Navy Conventional Ammunition Fuzes that meet the requirements as stated in the topic description. The company will demonstrate the feasibility of the concept in meeting Navy needs and will establish that the concept can be developed into a useful product for the Navy. Feasibility will be established by material testing and analytical modeling.

PHASE II: Based on the results of Phase I, the company will develop a prototype for evaluation. The prototype will be evaluated to determine its capability in meeting the performance goals and Navy requirements for a Reserve Power Solution for Navy Conventional Ammunition Fuzes. System performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters including numerous deployment cycles. Evaluation results will be used to refine the prototype into a design that will meet Navy requirements. The company will prepare a Phase III development plan to transition the technology to Navy use.

PHASE III: The company will support the Navy in transitioning the technology for Navy use. The company will develop a Reserve Power Solution for Navy Conventional Ammunition Fuzes according to the Phase III development plan for evaluation to determine its effectiveness in an operationally relevant environment. The company will support the Navy for test and validation to certify and qualify the system for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Thermal batteries present an attractive solution for both military and commercial needs due to their power output, zero maintenance requirements, and available small form factors. The Navy's requirement for increased runtimes in an even smaller package increases the technology's commercial attractiveness. For example, thermal batteries have found use in the Mars pathfinder exploration, used to propel the parachute motors, and other on-board rockets. This could be the beginning of a series of discoveries that could be applied to other fields.

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4. Swift, G., Thermophysical Properties of Lithium Alloys for Thermal Batteries, International Journal of Thermophysics, Springer Science and Business Media, New York, NY 2011.

KEYWORDS: Thermal battery; ammunition fuze; fuze power; reserve battery for fuzes; battery packaging for rise time and run time; battery heat management in munitions

TPOC:	David Mao
Phone:	(973)724-1908
Email:	david.mao@navy.mil
2nd TPOC:	Karla Rodriguez-Gonzalez
Phone:	(973)724-1908
Email:	karla.m.rodriguez@navy.mil

N151-061 TITLE: Air-Droppable At-Sea In-Water Lifting System

TECHNOLOGY AREAS: Ground/Sea Vehicles, Battlespace

ACQUISITION PROGRAM: Program Executive Office for Maritime (PEO-M, USSOCOM)

OBJECTIVE: Develop an Air-Droppable At-Sea In-Water Lifting System which can be air deployed from aircraft, land in the open ocean, self-erect, and lift floating containers (international standard [ISO] shipping containers of 20 and 40 foot length) to the deck of vessels of varying freeboard.

DESCRIPTION: US national and global security interests are protected by maintaining a (1) global forward presence and (2) the ability to rapidly deploy and sustain forces in any region of the world. Geo-political vicissitudes, budgetary realities, proliferation of technologies (offensive, defensive, and detection), and expanding the Department of Defense (DoD) distributed/disaggregated operations militate the development of alternatives/complements to traditional land-based options to support US short- and longer-term, and crisis response activity. Foremost among alternatives is maritime Advanced Force Sea-Basing (AFSB)—temporary at-sea forward operating bases. AFSBs vary immensely depending on operational requirements and environments; few will be sufficiently equipped to undertake at-sea recovery of containers. In order to maximize the efficacy of AFSBs and other vessels of opportunity, the DoD requires the ability to lift ISO shipping containers floating in the open ocean to the decks of vessels of varying freeboard and configuration; the lifting system must be platform agnostic. Neither current nor state-of-the-art maritime heavy-lift systems provide the capability to support this requirement. Beyond land-based heavy-lift considerations, at-sea heavy-lift is faced with unique environmental factors, including: wave force, height, and action; current; simultaneous dual platform roll, pitch, and yaw; sea water corrosiveness; and the impact of these dynamics on lift.

The objective is to develop an in-water heavy-lift prototype capable of fulfilling the following parameters:
• Air deployable from C-130, C-5, and C-17 aircraft (to include meeting all US heavy-lift aircraft transport and airdrop parameters)
• Configurable to fit within and be air-dropped in an ISO [or smaller] container
• Self-erecting (i.e., once in the ocean, the lift system can be assembled and made ready to operate (1) without assistance from the supported platform [except final maneuvering into position adjacent to and/or mooring to the supported platform], (2) with a minimum number of personnel [not to exceed four], and (3) with support from no more than two small craft, each equipped with a maximum 1 x 35 horsepower (hp) outboard motor [or equivalent]).
• Lift capacity:
  o weight: up to 20 tons
  o height: up to 10 meter freeboard
• Operating conditions: operational up to Beaufort Scale 4 [winds 13 - 17 mph; wave height 3.5 - 6 ft; small waves with breaking crests; fairly frequent whitecaps]
• Recoverable and reusable
• Deployable from surface vessels

This leap-ahead technology would also have tremendous utility to other public sector, non-governmental organizations (NGO), and commercial applications.

PHASE I: Develop initial concept design and model a heavy lift system that can meet the operating and environmental criteria outlined above. Perform modeling and simulation to demonstrate feasibility; identify points of greatest potential vulnerability and demonstrate mitigation designs. Construct and demonstrate rudimentary proof-of-concept model.

PHASE II: Based on Phase I work, construct a prototype system and demonstrate: (1) operational efficacy in a maritime environment across the range of environmental conditions outlined above, meeting minimum 50% capacity thresholds, (2) air-drop, self-erect, and in-water recovery viability, and (3) cost analysis for production of 25 lift systems. Identify applications and benefits to the commercial and private sectors.

PHASE III: Conduct a full-scale scenario operational demonstration of the Phase II prototype, dropping it from USG aircraft. Integrate into the broader FNC programs to demonstrate viability across the naval force. Develop plans for scaling up manufacturing capabilities and commercialization plans.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Industry, other governmental, and NGO organizations engaged in open-ocean, littoral, and riverine marine construction, disaster response, disaster relief and recovery, maritime recovery, and marine science and exploration—conducted in countries/regions possessing or lacking developed maritime infrastructure—will benefit from this product.

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2. A Cooperative Strategy for the 21st Century Seapower; OCT 2007; jointly released by the Chief of Naval Operations, Commandant of the US Marine Corps, and Commandant of the US Coast Guard; http://www.navy.mil/maritime/MaritimeStrategy.pdf

3. United States Special Operations Command: SOCOM 2020 Forging the Tip of the Spear; Admiral William McRaven, USN; http://www.defenseinnovationmarketplace.mil/resources/SOCOM2020Strategy.pdf

4. Naval Expeditionary Logistics: Enabling Operational Maneuver From the Sea; 1999; National Studies Board; http://www.dtic.mil/dtic/tr/fulltext/u2/a413072.pdf

KEYWORDS: Heavy maritime lift; at-sea recovery; ship loading /unloading at sea; ship-to-ship load transfer

TPOC: Theresa Paluszkiewicz
Email: terri.paluszkiewicz@navy.mil
2nd TPOC: Daniel Steward
Email: daniel.steward@navsoc.socom.mil

N151-062 TITLE: Electrochemically Assisted Safe Ionic Propellant

TECHNOLOGY AREAS: Space Platforms, Weapons

ACQUISITION PROGRAM: Ballistic Missile Defense System (BMDS) - Standard Missile 3 (SM-3) ACAT 1

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OBJECTIVE: Develop and formulate ionic monopropellant materials capable of providing environmentally safe, fully controllable, electrically ignitable propulsion thruster systems. Specifically, develop ionic monopropellant compositions that leverage an electrochemical on-off ignition process for advanced thrust control motors.

DESCRIPTION: The development of safe ionic propellants is important for potential shipboard applications. Electrical assisted ignition of an ionic monopropellant is an intriguing possibility for a controllable safe propulsion technology. Developing a robust electrochemically assisted process to convert ionic species from the monopropellant formulation (AF-M315E, LMP-103S, etc.) into an ignitable gas followed by ignition is the foremost goal of this topic. It is expected that the effort will require design and demonstration of a monopropellant formulation compatible with an electrical ignition process. Efforts should address the optimization of an ionic monopropellant formulation through modeling, experiments, detailed analytical chemistry, electrochemistry, and physics.

PHASE I: Perform an analysis and select promising novel materials for the development of solid and liquid ionic monopropellant candidates. Perform theoretical calculations of promising ionic systems which exceed the performance of Hydrazine/Dinitrogen Tetroxide (N_2O_4). Recommend and demonstrate the practicality of novel solid and liquid ionic monopropellants.

PHASE II: Develop and scale-up ionic monopropellant formulations that meet or exceed current hypergolic hydrazine formulations. In conjunction with a Navy designated test organization, demonstrate and optimize one or two selected formulations. Conduct performance and safety evaluations and down select to a single formulation for testing to determine suitability for US Navy use.

PHASE III: Manufacture ionic propellant formulation at pilot plant scale and demonstrate its safety and suitability for scale-up to full-scale production. Sufficient quantity of propellant formulation shall be provided for performance and safety testing. The small business will support the Navy with certifying and qualifying the ionic propellant for Navy use. When appropriate the small business will focus on scaling up manufacturing capabilities and commercialization plans. At the completion of this phase, the propellant composition will be ready for transition into a new electrically controlled Divert and Attitude Control System (DACS) for use in a missile system such as SM-3.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Ionic monopropellants have potential applicability for replacement of hydrazine/N2O4 hypergolic systems in commercial spacecraft for small engines and thrusters such as the Draco thrusters in SpaceX Dragon spacecraft.

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KEYWORDS: ionic; monopropellant; electrochemistry; AF-M315E, Ammonium Dinitramide; ADN; LMP-103S; hydroxyl ammonium nitrate; HAN

TPOC: Clifford Bedford
Email: clifford.bedford@navy.mil
2nd TPOC: Matthew Beyard
Email: matthew.beyard@navy.mil

N151-063 TITLE: Ultra-wideband Direct Digitization Above 50 GHz for Earth Observing Satellites

TECHNOLOGY AREAS: Sensors, Electronics, Space Platforms

ACQUISITION PROGRAM: WindSat Next

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Demonstrate an analog to digital converter (ADC) ideally suited for use in WindSat Next. The ADC should be capable of direct-to-digital reception (no down conversion) over subbands no narrower than 20-50 GHz in the 50-200 GHz spectral range. There is a strong preference for approaches that do not require down conversion to produce these subbands, but rather only use analog filtering. Signal sensitivity should exceed -140 dBm for < 10 millisecond collects simultaneously over the entire range. Especially desirable are ADC designs proven capable to harvest digital signal processing gain, e.g. for signals with information bandwidths below 1 MHz, without dynamic range saturation.

DESCRIPTION: Radiometry missions such as WindSat need to access portions of the spectrum that are uncontaminated by man-made signals. Increasingly, the best place to look for such pristine territory is above 40 GHz. That frequency range is largely unused for non-local communications or other radio frequency (RF) functions except for certain frequency bands which have relatively little atmospheric absorption. Short range communications (e.g., WiFi) and collision avoidance radars operate in the 60 GHz range while active denial systems and radars operate in the 94 GHz range. Hence the atomic absorption related emission bands, especially between 50 and 62 GHz and around 183 GHz, are largely uncontaminated by man-made signals and are ideal for space-based, earth atmospheric composition studies. None of these higher bands are used by today's WindSat. High sample speed analog-to-digital reception is needed to produce a lack of signal frequency ambiguity due to under-sampling. Extreme sensitivity is required to see the originally weak and heavily attenuated thermal noise (signals as small as -190 dBm) from orbit.

Currently WindSat analog limits signals to << 1 GHz subbands and down converts all signals before digitizing. Hence, there are 10 sets of expensive hardware (multiple local oscillators, mixers, and filters) for the 5 subbands and in 2 polarizations. Wideband direct reception with high sensitivity will allow much simpler RF hardware to do a better job of providing the weather data required for optimal operational planning of deployed missions.

PHASE I: Phase I work shall complete the simulink level modeling of the ADC defined in the proposal description and refine at least one critical subcomponent design though the circuit simulation phase of design. The required Phase II plan at the end of the Phase I base award should include a complete discussion of the technical issues that must be addressed to yield a well-functioning ADC by the effort's end and a strategy and time scale for coping with each. The option, if awarded should address the next most critical design issue. If subbanding is proposed, discuss in the proposal how signals spanning the divide would be handled and their reception proven feasible in Phase I.

PHASE II: Employ a sequence of increasingly complete design/fabricate/test cycles to demonstrate and quantify full ADC performance in the frequency range above 50 GHz.

PHASE III: If Phase II is successful, the small business will provide support in transitioning the technology for Navy use in the WindSatNext program. The small business will support the Navy with certifying and qualifying the system for Navy use and confirm that the Navy engineers are maximizing the utility of the ADC design. When appropriate the small business will focus on scaling up manufacturing capabilities and commercialization plans.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Transient digitizers and high speed scopes are long time markets for such ADC. Instrumentation in the way of programmable frequency scan spectrometers for atomic and molecular physics is another established application called real time spectroscopy. Applications in things like explosives detection are also possible.

REFERENCES:
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http://www.fujitsu.com/downloads/MICRO/fma/pdf/56G_ADC_FactSheet.pdf

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4. H. Suzuki, M. Oikawa, K. Nishii, and M. Hidaka, IEEE TRANSACTIONS ON APPLIED SUPERCONDUCTIVITY, VOL. 23, NO. 3, JUNE 2013.

KEYWORDS: Direct reception: under-sampling; analog to digital converters (ADC); radiometry; optical emission lines; high speed sampling

TPOC: Deborah VanVechten

Email: deborah.vanvechten@navy.mil
2nd TPOC: Michael Lovellette
Email: Michael.Lovellette@nrl.navy.mil

N151-064 TITLE: Cognitive Radio Architectures for Cyberspace Operations

TECHNOLOGY AREAS: Information Systems

ACQUISITION PROGRAM: JCREW, FNT 13-03

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a Cognitive Radio Architecture capability applied to future software-based tactical radio systems giving operators the ability to adapt their communications protocols in near real time.

DESCRIPTION: As general usage of microelectronic devices increases around the world, multiple competing vendors are attempting to capture a market share through the development of proprietary communications protocols designed for specific applications. Today, there are over 20 standard, wireless commercial protocols, but none of them can satisfy every application requirement. The military can no longer afford a different radio for each network it may wish to utilize or pay a high price to adopt an entirely new protocol. This effort seeks to develop an adaptive, next generation software defined radio (SDR) architecture capable of recognizing many standard protocols and variants, as well as the capability to cross-band the information traffic between any pair on the fly. The demonstration of such a design will minimize obsolescence and logistics costs while maximizing interoperability and adaptive functionality.

PHASE I: Define and assess existing spectrum sensing methodologies for an intelligent, agile radio system. Perform an analysis to identify the key strengths and weaknesses of each algorithm. Then, the performer should define and develop an innovative, new algorithm using the REDHAWK Software Communications Architecture (SCA) to monitor, sense, and detect the signal environment and then dynamically reconfigure to adapt to those operating conditions. Also, in considering radio frequency (RF) to internet protocol (IP) based systems, the performer should consider transmission of multiple forms of electronic media in the development of this algorithm. Finally, the performer should use MATLAB, Simulink, or another communication system simulation model to design a SDR system and implement the designed cognitive radio architecture algorithm. The level of fidelity of the simulation model is at the discretion of the performer, but the response to noise and interference inherent in real world environments must be modeled.

At the conclusion of this phase, the performer should provide a focused report on their algorithm with details on the SDRs behavior under different conditions using graphical and quantitative means.

The Phase I effort is unclassified.

PHASE II: Build a prototype model of the SDR system designed in Phase I. Tests should be conducted using commercial-of-the-shelf (COTS) hardware. The performer shall also investigate the usage of System-on-a-Chip (SoC) architectures to enhance the capabilities of the prototype SDR to enable various tactical missions such as electronic warfare, electronic attack, signals intelligence, direction finding/emitter tracking and real-time spectral awareness. Once the prototype is built, tests should be conducted using a wideband, RF channel emulator in a controlled environment. Additional testing at the discretion of the performer shall be conducted in the RF physical environment. Results from these tests will be communicated in an interim progress report to the Principal Investigator (PI) describing the hardware selected and performance in transmit and receive for various forms of digital media.

Following the review of the report and approval by PI, the performer will design and engineer a hand-held tactical system to be used in a relevant operational scenario. This handheld system shall include a visualization capability in order to deploy a spectrum analyzer. Multiple systems should be available for the testing and deployment. This operational test scheduled by the PI will occur during Phase II.

There is a high possibility that the Phase II effort will be classified.

PHASE III: If Phase II is successful, the small business will then work closely with the Naval Air Warfare Center Weapons Division (NAWC-WD) to provide technical guidance and algorithm implementation on tactical radio systems deployed on the Communications Emitting Sensing and Attacking System II (CESAS II) and Intrepid Tiger III (IT3). In addition, share the same algorithms to tactical communication systems under development at Space and Naval Warfare Systems Command Pacific (SSCPAC) PMW-120. The small business will work closely again with NAWC-WD to further develop the handheld device developed in Phase II in order to create a system integrated with CESAS II and IT3.

The science and technology developed in this SBIR will be used on both Navy and Marine Corps tactical systems.

Upon completion of all phases of this SBIR, the small business will create an executable specification of CESAS II, IT3, and the tactical handheld created in Simulink. This will ensure that future tactical communication systems will be able to implement the cognitive radio architecture developed under this SBIR.

There is a high possibility that the Phase III effort will be classified.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The cognitive architecture, tactical handheld system designed during this SBIR could potentially transfer to local, federal and state law enforcement.

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http://redhawksdr.github.io/Documentation/

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KEYWORDS: Open Systems Interconnection (OSI) Model; Spectrum Sensing; Interference; Digital Signal Processing; Path Loss; Multipath Fading

TPOC: Mr. John Moniz
Email: john.moniz@navy.mil
2nd TPOC: Capt Ben Pimentel
Email: benjamin.a.pimentel1@navy.mil

N151-065 TITLE: Innovative Power Electronic Switch for Naval Applications in Extreme Temperatures

TECHNOLOGY AREAS: Ground/Sea Vehicles, Materials/Processes, Electronics

ACQUISITION PROGRAM: FNC Power & Energy -FY14-01

OBJECTIVE: Demonstrate an innovative, ultra-power-dense power electronic switch that can operate in ambient thermal variations of -225°C to 150°C for high temperature superconducting (HTS) power systems with 200-300kW output power, >6MW/m^3 power density, a >200kHz frequency range, >98% efficiency, and self-contained thermal management.

DESCRIPTION: The Navy and US Marine Corps (USMC) are embarking on an aggressive power and energy program for applications in surface and underwater vehicles as well as expeditionary systems to be operated in harsh environments such as deserts, the arctic, and/or within HTS systems. In addition, limited by either shipboard space and weight or portability, the Navy and USMC require innovative technology solutions to increase electrical energy conversion efficiency and density in order to reduce fuel consumption, volume, weight, and life cycle cost. The goal is to demonstrate a power electronic switch for sea vehicles and expeditionary systems that can operate in ambient thermal variations of -225°C to 150°C for HTS power systems with 200-300kW output power, 6MW/m^3 power density, a >200kHz frequency range, >98% efficiency, and self-contained thermal management.

PHASE I: Determine technical feasibility and develop physics-based models in order to produce a converter design capable of meeting the goals and thresholds as detailed in the description.

PHASE II: Develop a prototype based on Phase I work for demonstration and validation. The prototype should be delivered at the end of Phase II. The design should be at Transition Readiness Level (TRL) 3 or 4 at the end of this phase.

PHASE III: Integrate the Phase II developed converter into the P&E-FY14-01 FNC program for transition to the Electric Ship Office acquisition program.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The desired electrical power converter has direct applications in commercial power grid, power distribution, electric power conversion, cryogenic power applications, arctic operations and transportation traction, making it broadly applicable to the commercial world.

REFERENCES:
1. D.G. Holmes and T.A. Lipo, Pulse Width Modulation for Power Converters: Principles and Practice, Number ISBN:0-471-20814-0. Wilsey.

2. Kolawa, E.A. and EE Technologies Study Team. Extreme Environment Technologies for Future Space Science Missions. Technical Report JPL D-32832, National Aeronautics and Space Administration, Washington, D.C., August 2007.

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8. DoD 5000.2-R, Appendix 6, pg. 204., Technology Readiness Levels and Their Definitions. http://www.acq.osd.mil/ie/bei/pm/ref-library/dodi/p50002r.pdf

KEYWORDS: Power Electronics; Electrical Converter; Efficiency; Extreme Temperature Operation; Enhanced Performance; Thermal Performance

TPOC: Lynn Petersen
Email: lynn.j.petersen@navy.mil
2nd TPOC: Brian Fitzpatrick
Email: Brian.Fitzpatrick@navy.mil

N151-066 TITLE: Soft Elastomeric Technology for Rapidly Deployable Manipulation Capability

TECHNOLOGY AREAS: Ground/Sea Vehicles

ACQUISITION PROGRAM: PMS 408 Explosive Ordnance Disposal & NAVFAC; Proposed POM-17 FNC ARMS

OBJECTIVE: Develop and demonstrate technologies to fabricate cost-effective rapidly deployable lightweight actuated inflatable single or dual arm manipulation systems for integration onto underwater unmanned platforms.

DESCRIPTION: Recent advances make it feasible to use compliant (elastomeric) materials in the fabrication of lightweight actuated inflatable manipulation systems which are resilient to impact, can be compactly stowed and are safe to operate near humans. Such manipulation systems would avoid costly motors by replacing them with pump driven fluid-filled fabric membranes. Nature provides many examples of animals that have developed superior strategies for manipulation of their surroundings through the use of soft, robust and fast mechanisms. These abilities have proven difficult to emulate with traditional engineering approaches, but new developments in inflatable technology using pressurized membranes made of compliant (elastomeric) materials create new opportunities for affordable manipulation systems for a range of naval underwater missions. The technical challenges include the design of integrated actuation and fabric, distributed actuation to mimic effective bio-inspired energy efficiency, and dexterity to perform an array of underwater tasks. The manipulation system can be a single or dual-manipulator configuration. It should be able to perform elementary tasks such as precise positioning of objects or tools, removal or emplacement of objects (lifting at least 25 pounds), and pull or twist manipulations (eg. unscrewing a cap from a pipe), which are common tasks performed in explosive ordnance disposal. The target specifications include either two symmetric arms, each with 7 degrees of freedom, or two asymmetric arms, one having 7 and the other 5 degrees of freedom, each arm weighing less than 8 pounds. End effectors should have at least 3 fingers. Ideally, these arms would be capable of operating on land or underwater, to depths of 200 feet.

PHASE I: Determine technical feasibility and define approaches for using compliant (elastomeric) materials to develop a single or dual-arm manipulation system capable of being integrated onto an unmanned underwater platform. The Phase I report shall clearly explain the operational capabilities and limitations of the technology. The results shall include a preliminary design for Phase II consideration.

PHASE II: Finalize the design and demonstrate a working prototype of the single or dual-arm manipulation system. Demonstrate the ability to perform tasks such as the precise positioning of tools or small objects, attachment of lift bags or removal lines to remove objects, surface preparation for adhering tools, and operations like pull or twist. The mechanism of stowage and deployment should be developed and the space requirements specified. A design for an integrated system with a suitable platform, such a hovering autonomous underwater vehicle like the Bluefin HAUV, should be specified.

PHASE III: Prepare final production design for the manipulation system, build the initial production unit and integrate into the acquisition program for deployment into the Fleet.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Maritime technology, oil and gas industries, mining, oceanography

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2. Naval Expeditionary Combat Command (NECC) Strategic Plan
http://www.dtic.mil/ndia/2011jointmissions/NECCStrategicPlan.PDF

3. iRobot's Inflatable Arm Could Be the Future of Grappling. http://gizmodo.com/5937046/irobots-inflatable-arm-could-be-the-future-of-grappling

4. Inflatable Robots by Otherlab: A Walking Robot (named Ant-Roach) and a Complete Arm (Plus Hand).
http://www.hizook.com/blog/2011/11/21/inflatable-robots-otherlab-walking-robot-named-ant-roach-and-complete-arm-plus-hand

KEYWORDS: Elastomeric manipulators; Unmanned Underwater Vehicle (UUV); compliant manipulators; soft robotics; explosive ordnance disposal (EOD)

TPOC:	Thomas McKenna
Email:	tom.mckenna@navy.mil
2nd TPOC:	Brian Almquist
Email:	brian.almquist@navy.mil

N151-067 TITLE: Orthogonal Approach to Malware Detection and Classification

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: Develop technologies and tools for detecting and classifying malwares using methods and techniques which are orthogonal to existing methods of binary/code analysis, binary and behavioral signatures.

DESCRIPTION: Today's networked computer systems are continuously under attack. Large and complex systems of software are difficult to completely verify and secure. These systems are vulnerable to compromises which take advantage of their weaknesses and flaws. Adversaries use these flaws and force access into our systems. Exacerbating the problem is the brittleness of current computing systems as initial penetration may quickly escalate to complete system control/compromise, rendering a computing system non-operational or worse, leading to corrupted, leaky and misleading information systems.

Current state-of-the-art practice for defending the system is mostly based on scan and patch processes. To protect against exploits and attacks, the system often employs a perimeter defense which scan files and executables as they enter the system to detect (and sometime classify) potential exploits. The detection process relies on binary as well as behavioral signature filtering and heuristics which are slow to react to new threats and unable to keep up with novel attack vectors. The polymorphic and metamorphic obfuscation techniques for malware and exploits, along with availability of toolkits for generating the exploits, make malware/exploit production relatively inexpensive. The adversary can use the same obfuscation techniques and toolkits to continually produce seemingly new exploits and continually evade detections. A battle is being fought between cyber defender and attacker in the code analysis or binary and behavioral signature front.

While this binary/behavioral signatures battle front is being fought, it may be beneficial for defender to open several more cyber battle fronts to make it more expensive for the adversary to develop successful/undetected exploits. A new cyber battle front implies that it employs new detection vectors which is/are orthogonal (independent) to the current techniques of binary/behavioral signature based detections, such as [1,2,3,4]. We are hoping that these novel orthogonal detection techniques can raise the difficulty factor and cost for successfully developing and deploying an exploit or malware by requiring attackers to contend with many distinct and orthogonal detection vectors, multiplying their cost. Orthogonal detections can help reduce the sheer number of malwares and exploits targeted toward our military networked computing systems.

This topic solicits the development of technologies and tools for detecting and classifying malware using approaches which are independent or orthogonal to the current family of malware detection techniques. Current malware detection techniques rely on code or binary analysis and binary and behavioral signatures. If successful, the tools and techniques developed in this SBIR can significantly raise the cost for developing exploits by requiring the attackers to evade a large number of orthogonal detection techniques, and thus reduce the sheer number of the distinct exploits targeting our networked computing systems.

PHASE I: Investigate and develop a novel technique and tools for reliably detecting and classifying malware, orthogonal to current generation of malware detection techniques. Develop proof of concept prototype and identify the metrics that determine the prototype's efficacy.

PHASE II: Develop and enhance the prototype into a fully functioning tool. Demonstrate and evaluate the capability of the tool on a large number of actual malware, constructed new malware variants and benign programs. Address potential deficiencies and enhance the performance and robustness of the technique and tool.

PHASE III: Upon successful completion of phase II, the small business will provide support in transitioning the technology for Navy use. The small business will develop a plan for integrating the product into the Navy's information infrastructure and to determine the effectiveness of the novel orthogonal malware detection techniques in an operationally relevant environment. The small business will support the Navy with certifying and qualifying the system for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: A novel orthogonal exploit detection tool can be independently marketed or integrated into current computer security product offerings, providing defense in malware detection area. If successful, the tool developed within this SBIR should find its market in the commercial sector as well as military sector.

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KEYWORDS: malware similarity, malware detection, malware classification, malware signature, defense-in-depth, multi-vantage-point detection

TPOC: Sukarno Mertoguno
Email: sukarno.mertoguno@navy.mil
2nd TPOC: Carey Schwartz
Email: carey.schwartz@navy.mil

N151-068 TITLE: Ultra-High Temperature Thermoelectrics

TECHNOLOGY AREAS: Air Platform, Materials/Processes, Weapons

ACQUISITION PROGRAM: Navy Conventional Prompt Global Strike, DARPA Tactical Boost Glide Demo

OBJECTIVE: Develop thermoelectric technology which converts aerodynamic heating into electricity via thermoelectric generators. Thermoelectrics could provide power for Hypersonic/Long Range vehicles which require significant electrical power while surviving temperatures greater than 1250 degrees C.

DESCRIPTION: Hypersonic vehicles need compact, high temperature capable power sources. Batteries are not sufficiently compact and require insulation. A thermoelectric (TE) energy-harvesting system takes advantage of the temperature difference between two surfaces converting thermal energy into electricity. The objective of this effort would be to push the temperature limits of current TE materials from approximately 600 degrees C to 1250 degrees C while achieving an effectiveness figure of merit (ZT) above 1. Currently, efficiencies are limited by the interdependence of thermal and electrical properties. Due to the lack of space available for coolant, TE concepts will need to be integrated with low thermal diffusivity insulators or with high temperature phase change materials. As the output of TE generators is a function of the temperature difference between hot and cold sides, the output will be dependent on the generators' ability to separate the sides with insulating or phase change materials.

To date, thermoelectric generators have been designed for operation up to 600 degrees C. Many materials have an upper temperature limit of operation, above which the material is unstable. Theoretical and experimental studies have shown that low-dimensional TE materials, such as super-lattices and nano-wires, can enhance the Thermoelectric Effectiveness (ZT).

Currently, material science include bulk materials, low-dimensional materials, nano-crystalline materials, doping, molecular rattling, multiphase nano-composites, silicon-germanium alloys, high temperature capable clathrates, homologous oxide compounds, Skutterudite materials, and Half Heusler alloys. This list refers to current approaches and is not prescriptive for proposed approach.

PHASE I: Develop thermoelectric generator concepts using high melt temperature materials. Develop thermoelectric material-to-insulation or phase change material integrated configurations. Perform measurements of candidate material electrical conductivity, thermal conductivity, and Seebeck coefficient as a function of temperature up to the expected maximum use temperature. Perform imaging of candidate material grain and lattice structure at temperatures spanning the range of interest. Develop predictions of expected TE figure of merit and thermoelectric efficiency. If awarded a Phase I Option, perform imaging of candidate material grain and lattice structure at temperatures spanning the range of interest. Develop morphology and structure of the TE devices from the imaging data.

PHASE II: Using the data developed in the Phase I option, identify material modifications to improve generator performance. A prototype thermoelectric generator will be fabricated and integrated with insulation. Laboratory tests will be conducted to measure the electrical output of the integrated thermoelectric generator-insulator circuit at temperatures spanning the range of interest. Sizing of 100 and 250 W devices based on the results of prototype test will be projected. Designs capable of meeting expected missile form factors and combined mechanical and thermal environments will be developed and demonstrated in relevant mechanical and thermal environments. Key cost, size and performance attributes will be developed for commercial application. Designs for commercial application will be developed and demonstrated.

PHASE III: Develop revisions to the single unit fabrication methods to meet quality requirements. Identify revisions to the prototype to meet quality requirements, leading to fabrication of additional 20 final prototypes which will be subjected to quality inspection, electrical performance testing over the temperature span, and combined thermal/mechanical loads testing. Identify large scale production alternatives. Develop a cost model of expected large scale production to provide estimates of non-recurring and recurring unit production costs. Production concept for commercial application will be developed addressing commercial cost and quality targets.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Commercial and dual applications of this technology include electrical power supplies for satellites, fuel cells and combustion driven engines such as for aircraft and ground transportation. By harvesting combustion engine waste heat, the overall efficiency of these engines is improved. A further use is to provide back up to solar photovoltaic cells.

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KEYWORDS: thermoelectric efficiency; Seebeck effect; nanostructured materials; molecular rattling; multi-phase nano-composites; complex crystals; thin film superlattices; clathrates

TPOC: Gil Graff
Email: gil.graff@navy.mil
2nd TPOC: Rick Burnes
Email: richard.burnes@navy.mil

N151-069 TITLE: Medical Informatics Decision Assistance and Support (MIDAS)

TECHNOLOGY AREAS: Information Systems, Biomedical, Human Systems

ACQUISITION PROGRAM: Defense Health Program (DHP) or Marine Corps Systems Command

OBJECTIVE: Develop and demonstrate a modeling and simulation-based technology, capable of running on a handheld device, which provides an unambiguous interpretation of health status, pre- and/or post- injury, to medical information consumers within and outside military medical channels.

DESCRIPTION: The continued conflict in Afghanistan and the aftermath of Iraq, combined with emerging challenges across multiple continents, has led to increased demands for medical treatment, both on the battlefield and across the whole continuum of care to the warfighter. These drivers have, in turn, led to greater demands on the medical community to assimilate increasing amounts of information across a range of patient care levels, across a spectrum of caregivers, and at a variety of locations. This explosion of information, and in the number of individuals who participate in generating and using this information, carries with it a greater risk for misinterpretation, miscoding and mishandling. To avoid these risks, there is a critical need to optimize the acquisition, storage, retrieval, and use of healthcare- related information for each patient in order to ensure consistent and timely care [1]. The increasingly large data sets that represent an individual patient’s health status, coupled with the growing number of practitioners who may be assisting in the treatment, require decision support tools that support rapid and accurate pattern classification and hypothesis testing. As well, more effective ways of storing and retrieving patient histories are needed to ensure effective diagnosis and treatment. Modeling and simulation technologies provide the basis for aggregating, analyzing, representing, and making forecasts from large quantities of healthcare data, making them accessible in multiple ways to the many individuals supporting a patient’s care [2].

Handheld devices such as cell phones, smart phones, and personal data assistants (PDAs) provide an effective source for collecting, analyzing, and widely disseminating healthcare information, due in large part to their significantly expanded computational processing capability [3]. The infrastructure for developing software applications that can exploit these advances is also rapidly maturing; the FDA estimates over 500 million individuals will be using a healthcare app by 2015 [4]. Moreover, the types of information collectable by current mobile devices have expanded to include: high resolution pictures; video; text; geographic location; and, in most cases, text-based annotations. Combined, these developments should enable current mobile devices to perform complex analyses based on diverse, and often times incomplete, data sets enabling improved healthcare access, availability, and effectiveness for caregivers.

This topic is requesting development of Medical Informatics Decision Assistance and Support (MIDAS) technologies which, by merging advances in computer science, information technology, and information science, will provide:
• Data acquisition tools that capture and combine all relevant healthcare information (e.g., images, paper documents, proteomic/genomic data, etc.) into a common repository to allow access via searches and queries
• Visualization and analysis tools that allow users to integrate and interact with the data to generate and test new diagnoses and treatment methodologies
• Applications to detect novel patterns, predict adverse events and conditions, and to optimize treatment plans
• Platform independence to allow distribution, portability, and interoperability between different systems
• Data warehousing, archiving, and retrieval to support continuum of care and electronic health record data exchange

The output from MIDAS technologies should enable medical practitioners across the healthcare treatment continuum to better understand the medical status of a patient; to easily include treatment and diagnosis approaches while better understanding proximate and distal risk factors; and to develop effective courses of action.

PHASE I: Required Phase I deliverables will include determining technical feasibility for handheld applications that can provide simple, easy-to-use interfaces for aggregating, analyzing, representing, and making forecasts from large quantities of healthcare data that are input and used by multiple medical practitioners for use in the operational setting. Develop an initial concept design and model key elements as well as a detailed outline of success criteria. A final report will be generated including system performance metrics and plans for Phase II, if awarded. Ensuring an 'open design' to allow integration with other Military Health System's information systems will be considered a critical performance metric. Phase II plans should include key component technological milestones and plans for at least one operational test and evaluation. Phase I should also include the processing and submission of all required human subjects use protocols should these be required. Due to the long review times involved, human subject research is strongly discouraged during Phase I.

PHASE II: Required Phase II deliverables will include the construction, demonstration and validation of a prototype MIDAS system based on results from Phase I. All appropriate engineering testing will be performed along with a critical design review to finalize the design. Additional deliverables include: 1) a working prototype of the sensor, 2) drawings and specification for its construction, and 3) test data on its performance collected in one or more simulated operational settings, in accordance with the demo success criteria developed in Phase I.

PHASE III: Provide support in transitioning the technology for Marine Corps use. In accordance with the Phase III development plan, the company will extend the scope use to a wider range of platforms that are included within the Marine Corps Trusted Handheld program. The small business will provide support for test and validation and qualify the system for Marine Corps use. The small business will transition a package to the Marine Corps that includes user training package – e.g. user manual, training materials.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology will have broad application in commercial as well as military settings. It will provide military medical practitioners across the healthcare treatment continuum with tools to better understand the medical status of a patient, in order to easily include treatment and diagnosis approaches while better understanding proximate and distal risk factors, and to develop effective courses of action which will significantly improve their performance and increase the rates of survivability for medical casualties. Commercially, this technology should allow for similar types of improvements in emergency rooms and trauma centers.

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KEYWORDS: Mobile Device; Applications; Medical Informatics; Data Collection; Forecasting; Military Health System; Medical Readiness

TPOC: Peter Squire
Email: peter.squire@navy.mil
2nd TPOC: Christopher Steele
Email: christopher.steele4@navy.mil

N151-070 TITLE: Development of Marinized Protective Coatings for Higher Temperature Operations of Marine Gas Turbine Engines

TECHNOLOGY AREAS: Ground/Sea Vehicles, Materials/Processes, Battlespace

ACQUISITION PROGRAM: EPE FY15-02 Gas Turbine Development for Reduced Total Ownership Cost (TOC)

OBJECTIVE: Develop an Integrated Computational Materials (Science) and Engineering (ICME) related methodology to predict and develop compatible marinized materials/coatings upgrades for Navy surface ship propulsion or auxiliary power gas turbines that will maintain long hot section life at sustained higher operating temperatures leading to reduced maintenance and repair budgets.

DESCRIPTION: It is the Navy’s goal to increase the operational capabilities of its gas turbine engines that are used in Surface Fleet propulsion and auxiliary electrical power generation. Operational changes and future needs will require increased gas turbine operating temperatures and change the associated operating environment to one where Type I and Type II hot corrosion AND oxidation will be prevalent in newly anticipated operational profiles. The U.S. Navy (USN) shipboard environment (the marine environment) is high in salt-laden air and water, which coupled with air and fuel sulfur species, causes aggressive Type I and Type II hot corrosion in gas turbine hot sections. Higher temperatures and environmental changes will increase engine corrosion and oxidation rates thereby shortening engine life and increasing engine maintenance and repair costs. Current USN Hot Section Materials were designed for Low Temperature Hot Corrosion (~700°C), but new USN operations may require engine materials to withstand higher sustained temperatures (950-1050°C) and cycle more often reducing engine life severely. Current coating development has been empirically based and has not been linked on computational/ scientific/ experimental data where predictive models could lessen time and cost for the development of corrosion-resistant and oxidation-resistant robust coatings capable of higher temperature service. This program would incorporate a computational and an experimental base to develop predictive models that will guide creation and development of coatings that are resistive to high temperature corrosion (including hot corrosion) and oxidation in the Navy's higher temperature operational profile.

PHASE I: Explore the coating literature as related to marine propulsion and develop coatings that would indicate the ability to perform at higher temperatures. Then perform short-term (~200 hours) high temperature experiments to correlate coating chemistry with hot corrosion and oxidation performance. The correlations should begin to form the ICME framework to assist in maximizing corrosion and oxidation resistance by changes in coating chemistry while not impacting fatigue, creep, or substrate strength of the substrate alloys.

PHASE II: The ICME framework shall be further expanded to include compatibility of the coating to different alloy substrates as well as further development, modification, and maturation of the ICME models. Coating and engine original gas turbine equipment manufacturers (OEMs) should be consulted for advice and direction for further developments of the ICME models. The performer shall correlate into the ICME-derived model the interaction of chromium and aluminum content in a coating that leads to the formation of chromia or alumina scales. Coatings on several alloys shall be tested to determine coating compatibility and assess impact of coatings on alloy substrate properties. Coatings shall be applied onto alloy substrates by at least one recognized commercial coating process (line-of-sight and/or non-line-of-sight).

PHASE III: The ICME model will be further developed and matured through the expansion of coating chemistry and hot corrosion and oxidation resistance testing results. The expected deliverables will be: (1) optimized corrosion and oxidation-resistant coatings for a given set of alloys and (2) an ICME-derived model that would predict and assist in the development of future coatings that are compatible to other alloy substrates. In Phase III, the performer shall correlate the interaction of the substrate alloy to the coatings' ability to form chromia or alumina scales, especially when the substrate is a single crystal versus a polycrystalline alloy. A partnership between the small business and an engine OEM would be encouraged in order to further improve chances of transition.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Development of more robust coatings able to withstand hot corrosion and oxidation at higher temperatures for U.S. Navy applications will also enable more efficient service for commercial applications. Marine gas turbine engines are industrial gas turbines that are intended for Naval use. Successful development of better coatings for the current alloys, capable of extended service in the highly corrosive Naval operating environment, should enable subsequent use in commercial applications if the business case justifies the results.

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KEYWORDS: Hot corrosion; oxidation; coatings; gas turbines; marinization; marinized alloys, interdiffusion

TPOC: David Shifler
Email: david.shifler@navy.mil
2nd TPOC: Donald Hoffman
Email: donald.hoffman@navy.mil

N151-071 TITLE: Offensive Mine Warfare (MIW) Planning and Assessment Software Framework

TECHNOLOGY AREAS: Information Systems, Weapons

ACQUISITION PROGRAM: FNC SHD-FY14-04 Advanced Undersea Weapon System (AUWS) Enabling Capability

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an integrated software framework for offensive Mine Warfare (MIW) mission planning and assessment capabilities which supports both traditional mining as well as future concepts that utilize distributed vehicles, sensors, weapons and other disruptive effects.

DESCRIPTION: Future minefields will use precision emplaced unmanned systems requiring interactions among many functional elements, battle-space environments, and adversarial courses of actions. Performance predictions using stand-alone models will become infeasible and render current minefield planning methods ineffective. Currently, there are a number of gaps within minefield planning, modeling, and simulation capabilities. With the emergence of new mining technologies, new software methodologies are needed to investigate capabilities, drive new requirements and measures of effectiveness, address training needs, and to meet Navy strategic goals.

An integrated set of decision support technologies is required that:
a. Automates data exchange and model execution for MIW planning and analysis using advanced theory
b. Supports supplemental data when available (e.g., environmental, target features, traffic patterns, operational constraints)
c. Provides a robust set of Measure of Effectiveness (MOE) criteria for field planning beyond Simple Initial Threat (SIT)
d. Is consistent with modular, open-architecture standards and interfaces with legacy models and databases
e. Is compatible with higher-level Joint and Naval planning systems/software and Common Operating Picture (COP) such as MEDAL and GCCS which have standard interface requirements.
f. Provides user-interactive display of graphical charts and minefield mapping capabilities
g. Produces a standard set of offensive MIW planning products/folders incorporating the planning and assessment results

PHASE I: Identify framework requirements and what offensive MIW technologies and planning tools are currently available, what information and integrations should be included, and what methodologies best support the objective. Given an initial set of stakeholders and applicable systems, conduct research to identify other stakeholders, users, applicable delivery platforms and effectors that could potentially utilize the new integrated software framework. Identify all supporting data requirements and any existing data gaps which will limit/prohibit minefield planning and assessment. Once the framework requirements are complete, a detailed road map document will be developed describing the high level design and the required development and integration tasks needed to create the offensive MIW planning and simulation software framework. The company will prepare a Phase II development plan to prototype the offensive MIW planning and simulation software framework.

PHASE II: Develop a prototype offensive MIW planning and simulation software framework for evaluation, based on the results of Phase I. The prototype will be evaluated to determine its capability to meet the performance goals defined in the Phase II development plan and Navy requirements. Demonstrate system performance through prototype evaluation and modeling or analytical methods over the required range of parameters. Sample unclassified data sets and interface stubs will be used to represent interfaces to actual databases and Joint/Navy planning systems. Evaluation results will be used to refine the prototype into a design that will meet Navy requirements. The company will prepare a Phase III development plan to transition the technology to Navy use.

PHASE III: Develop a fully operational offensive MIW planning and simulation software framework including interfaces to all necessary models and databases and support Naval technology demonstration transition. The framework will be demonstrated working with applicable Joint/Navy planning systems and COPs to determine its effectiveness in an operationally relevant environment. The framework will output standard Navy offensive MIW planning products and assessment results/MOEs. The framework will be evaluated to determine its capability in meeting the performance goals defined in the Phase III development plan. The company will support the Navy for test and validation to certify and qualify the system for Navy use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This integrated software framework could have applicability for planning passive and actives systems to defend commercial undersea resources and infrastructure.

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KEYWORDS: Integrated software framework; Minefield planning; Minefield assessment; Precision emplaced effects; Distributed systems optimization; Open architecture

TPOC: Scott Burleson
Email: scott.d.burleson@navy.mil
2nd TPOC: David Everhart
Email: david.e.everhart@navy.mil

N151-072 TITLE: Resin Infusible Carbon Fiber Unidirectional Broadgoods for Fatigue Dominated Applications

TECHNOLOGY AREAS: Air Platform, Ground/Sea Vehicles, Materials/Processes

OBJECTIVE: Develop unstitched, uncrimped, dry carbon fiber unidirectional broadgoods intended for manufacturing of composite structures by resin infusion with the purpose of increased fatigue performance.

DESCRIPTION: Infused carbon epoxy composite laminate fatigue specimens were exhibiting lower than expected fatigue runout strains (at 10 million cycles, R=-1), and the observed fatigue degradation was initiating as microcracks at the stitching in the 90 degree plies of a laminate containing 0, +/-45, and 90 degree plies. Follow on screening tests of variations on the unidirectional fabric, such as thinner or different stitching threads, did not show any improvements. Stitching is the usual method of holding unidirectional fibers together forming a dry fabric used for wet resin fabrication methods, such as the infusion process used here. Autoclave cured unidirectional prepreg, which is held together by the B-staged epoxy resin rather than stitching, exhibits higher fatigue runout strains, but when compared to infusion the autoclave process significantly increases the cost of manufacturing.

This SBIR focuses on developing dry carbon unidirectional broadgoods consisting of straight fibers with no features that can create stress concentrations or resin rich areas, while maintaining a 55% fiber volume fraction when infused. The technology can be developed using standard modulus carbon fibers but should be extendable to intermediate and higher modulus fibers. The technology should be applicable to unidirectional cure ply thickness ranging from 0.005” to 0.025” - the researchers feel that thinner plies will improve fatigue performance, but there will be a tradeoff since thicker plies reduces manufacturing costs. The fatigue performance goal for a quasi-isotropic laminate (layup [0/45/90/-45]ns) using the unidirectional broadgoods is runout at 10 million cycles, R=-1, at 3000 microstrain, with the specimens exhibiting no microcracking.

PHASE I: Develop concept(s) for dry fabric and demonstrate feasibility at lab scale using the specifications cited in the Description. Feasibility includes: demonstration of the technique used to form broadgoods from fiber tows; show that the dry fabric can maintain its shape when handled and draped dry; and show that it can be resin infused (epoxy resin TBD).

Phase I Option, if awarded, would be initial set up for Phase II, including planning and purchasing any long lead items.

PHASE II: Refine the concept to represent production material and show that good quality laminates can be infused. Quality would be assessed by conducting material testing to measure volume fractions, microscopy inspection, and 90 degree tensile performance (or another test to show good fiber matrix bond). Fabricate enough broadgoods for a panel 24” x 24” x 0.25” thick. Fabricate a laminate by resin infusion (resin TBD), and cut and test specimens. Conduct mechanical tests of composite specimens, including fatigue screening (+/- 5000 microstrain), and fatigue threshold (goal is at least +/- 3000 microstrain for 10 million cycles).

PHASE III: Coordinate with follow on programs of the FNC to incorporate material into next generation composite structural designs. Tasks will include developing the material database, conducting long term structural evaluation of large scale beams (6” thick), and manufacturing a full scale part with complex curvature as part of certifying and qualifying the material for Navy use. When appropriate the small business will focus on scaling up manufacturing capabilities and commercialization plans.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Composite structures with design envelopes controlled by cost and fatigue would benefit from this technology. These structures exist extensively in the energy and transportation industries. Composites are used in parts and structures such as shafting, wind turbine blade, trailers, bridges, equipment foundations, and springs.

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KEYWORDS: Composite; Carbon Fiber; Epoxy; Fatigue; Resin Infusion; VARTM

TPOC: Ignacio Perez
Email: ignacio.perez1@navy.mil
2nd TPOC: Paul Coffin
Email: paul.coffin@navy.mil

N151-073 TITLE: Enhanced Cell Designs for Improved Internal Heat Transfer for High Rate and Power Capable, Large-Format Batteries

TECHNOLOGY AREAS: Materials/Processes, Electronics, Weapons

ACQUISITION PROGRAM: Multi-Mission Energy Storage FNC, Railgun INP

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Optimize heat transfer and cell design for large, high rate Lithium (Li)-ion cells for supporting pulsed power applications.

DESCRIPTION: Energy storage is a key enabling subsystem for supporting future shipboard loads. To date, industry and academia have performed substantial innovative work that has resulted in a continuous improvement in energy density of batteries destined for high energy applications. However, the capability of the high energy cells and chemistries developed do not necessarily apply to the rates and modes of operations required for shipboard applications. High power batteries have also undergone beneficial development and improvement; however, these improvements have generally focused on new chemistries or battery designs which reduce impedance and increase energy density while retaining power. The missing developmental area in the space of large-format high power batteries is internal, cell-level thermal management. This has typically been a challenge in the large-format battery space because of the increased length scale over which thermal energy must transfer. However, large-format batteries are essential for simplified, more manageable large-scale systems. Within large-scale shipboard energy storage systems, reduction of the number of components and connectors will be key for ensuring reliability while minimizing Direct Current (DC) losses, particularly at high rate and deep discharge (high current). Large-format storage offers the potential for maximizing reliability and reducing maintenance requirements by minimizing connectivity and monitoring points. To reduce the number of components, the cell format must be increased beyond commercially available 18650 or 26650 cylindrical cells, while retaining or improving upon performance, density and thermal character, and focusing upon safer yet well-characterized chemistries, preferably phosphate or titanate-based approaches.

Increased scale of cells present unique challenges, particularly as operational rate and depth of discharge increases. Larger designs can present thermal resistance issues due to design attributes that impede heat flow in certain directions. As the operational rate increases to 10C or higher to support pulsed power and directed energy applications, these challenges are manifested further. The greater rate of heat generation and higher inefficiency (losses) cannot be easily removed from within the cell. Thus, as cell format increases, the pathway for thermal conduction outward from the cell becomes more resistive (as diameter and length increase). Reduction of the conduction pathway in large format cells is thus an important and desirable trait that requires innovative approaches and investment. This is the case for both cylindrical as well as prismatic designs.

Innovative approaches are desired to enable larger and higher capacity cells capable of performance and efficiency at rate (>10C). The intent is to minimize thermal resistance either through improved cell construction materials (not electrochemical couples or electrolytes), improved material interfaces, improved cell design/construction, or a combination thereof. Specifically, this is a hardware-oriented effort, and so emphasis is made on innovation in the hardware design approaches, as well as on the ability to prove the innovative hardware in a practical manner as early as Phase I. The end intent is reduced conduction path resistance within a large format cell of over 20Ah. Innovation is also necessary such that the cell energy density is minimally impacted with such re-design, so that the benefits at the system-level can be manifested.

PHASE I: Develop proof of concept of a large-format battery cell with innovative thermal approaches. This includes a workable chemistry and electrode approach at a reasonable hardware scale to demonstrate performance at rate. Such a demonstration cell shall include relevant conduction path lengths and support detailed modeling and simulation, or other approaches to indicate the performance of cells at scale, in accordance with the Phase II requirements. The Phase I goal is to deliver a small number of these innovative cells for abuse testing by either the vendor or the Navy in order to help identify weaknesses in the design.

In the Phase I Option, if awarded, a detailed design of the full scale cell shall be completed, based upon cell test results.

PHASE II: Develop, fabricate and demonstrate a cell and battery design suitable for operation at 1000V and 10C (thr) to 30C (obj), using 40°C liquid cooling only. The design shall be suitable for compact racking and operation in tight applications and in spaces with ambient temperatures up to 60°C. The design should be able to transfer heat to the cooling media in such a manner that upon completion of a full discharge (=80% DOD) at rated conditions, the cells can immediately undergo charge at a 2C rate (thr) or higher (15C, obj), and repeat this continually. The effort will deliver cells and modules to support safety evaluation of the approach, and will deliver a battery pack of minimum 20Ah, 1000V, including Battery Management System BMS and any necessary balance of plant for a system demonstration.

PHASE III: Perform sufficient engineering to support evaluation of safety for fully racked and enclosed batteries under the necessary Navy safety test efforts. Provide battery systems for evaluation under shock, vibration and thermal propagation scenarios. Deliver full packaged battery string with suitable design basis to build and integrate into future applications.

The small business will support the Navy with certifying and qualifying the batteries for Navy use on the appropriate platforms. When appropriate the small business will focus on scaling up manufacturing capabilities and commercialization plans for domestic cell manufacture and modularization.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The electric utility industry uses large battery bank installations in lieu of "peaker plants" in order to level load the power generation requirements during peak time of day. The automotive and marine industries are transitioning to electric drive. These large-format high-power batteries would be directly relevant for these applications and would furthermore reduce Department of Defense (DoD) procurement costs with the economy of scale of manufacturing for multiple industrial sectors.

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KEYWORDS: Energy storage; Electrochemistry; thermal design; large-format cell design; high power battery; Li-ion battery; heat transfer

TPOC: Benjamin McGlasson
Email: ben.mcglasson@navy.mil
2nd TPOC: John Heinzel
Email: john.heinzel@navy.mil

N151-074 TITLE: Acoustic Signature Bundling for Classification

TECHNOLOGY AREAS: Information Systems, Sensors

ACQUISITION PROGRAM: Passive Sonar Automation Technology EC; PMS 485, Fixed Surveillance System

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an algorithm and approach to determine the acoustic signature (Broadband, Narrowband, and Intermittent) for sonar contacts. Future systems will require automation with conditional probabilistic reasoning across distributed sensor fields. Advances are sought in acoustic signature bundling to enable automation of detection, classification, localization & tracking of acoustic and non-acoustic contacts so as to significantly reduce the operational workload associated with contact evaluation.

DESCRIPTION: Current Navy tactical and surveillance sonar systems include automation to simplify operational tasking, yet often still require all key detections and assertions to be controlled and managed by the trained operators. Burdens placed on trained operators are only increasing in light of (a) expansions in system implementations and in the number of beams requiring review, (b) improvements in beamformer-based target detection capabilities, (c) proliferation of clutter-like contacts through which an operator must sort, (d) increases in operational training costs, and (e) simultaneous reductions in force. Operational workload requirements are now a key inhibitor of system implementation and deployment options, and are key components of system life-cycle costs. The Navy is in need of improved autonomous system concepts that significantly reduce required operator involvement and that ultimately enable fully autonomous implementation. At present, the sonar operator analyzes contact followers manually. An ongoing Enabling Capability project will produce meta-data tags for a set of surface ship generated signals that could confuse submarine classification algorithms. This topic pursues a more desirable approach for signal association for spectral classification.

PHASE I: Determine technical feasibility of the proposed approach with the goal to correctly associate all acoustic evidence presented from an individual sonar contact. Develop a concept for contact component tracking and association/bundling, integrated attribute estimation, and data association and classification processing that is applicable to large sensor fields. Demonstrate the feasibility of the concept in meeting Navy needs and establish that the concept can be developed into a useful product for the Navy. Feasibility will be established by analytical modeling and/or analysis. Provide a Phase II development plan that addresses technical risk reduction and provides performance goals and key technical milestones.

PHASE II: Based on the results of Phase I and the Phase II development plan, develop a prototype for evaluation. The prototype will be evaluated to determine its capability in meeting the performance goals defined in Phase II development plan and Navy requirements for automated detection, classification, localization, and tracking across a field of sensors, with full association, re-acquisition, and behavioral reasoning capabilities. System performance will be demonstrated through prototype evaluation with operational data and modeling or analytical methods over the required range of parameters. Evaluation results will be used to refine the prototype into an initial design that will meet Navy requirements. Prepare a Phase III development plan to transition the technology to Navy use.

PHASE III: If Phase II is successful, the small business will be expected to support the Navy in transitioning the technology for Navy use with Fixed Surveillance Systems. The company will refine automation, data association, and classification processing techniques according to the Phase III development plan for evaluation to determine its effectiveness in an operationally relevant environment. The small business will support the Navy for testing and validation to certify and qualify the system for Navy use as part of the Integrated Undersea Surveillance System.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Automated signature bundling is expected to be fully applicable to arbitrary suites of sensors, including mobile unmanned aerial vehicle/unmanned underwater vehicles/ UAV/UUV sensors operating either independently or jointly with other distributed sensors. Applications within the medical industry are also anticipated, where, for example, multiple ultrasonic transducers are used for tracking anomalies in tissue.

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KEYWORDS: Fixed System, acoustic surveillance, workload reduction, undersea dominance

TPOC: Michael Vaccaro
Email: michael.vaccaro@navy.mil
2nd TPOC: Susan LaShomb

Email: susan.lashomb@navy.mil

N151-075 TITLE: Technology for Ship to Shore Connector Concepts with Combined High Speed and Payload Fraction

TECHNOLOGY AREAS: Ground/Sea Vehicles

ACQUISITION PROGRAM: PEO Land Systems, Amphibious Combat Vehicle Program

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Determine technologies applicable for ship to shore surface connectors including hydrodynamic, propulsive, or structural concepts that result in vehicles with high speed (>20 knots), cargo capacity (75 tons or greater), while compatible with the constraints of operating from the well deck of an amphibious ship.

DESCRIPTION: Develop concepts based on innovative technology for a surface connector craft to transport equipment, material and personnel from a host vessel constituting a Sea Base which may be from 65 nautical miles (nm) to 200 nm offshore from the beach. The connector will need to operate and transit in sea conditions up through the top end of NATO Sea State 3 (Objective SS4). The Sea Base may be an amphibious ship equipped with a well deck capable of dry or flooded operation. The connector must be compatible with operating from a well deck, including refueling, allowing for scenarios when no fueling ashore or en route is anticipated. The objective is to carry a full payload on each leg of the round trip to address the need for retrograde transport from the beach to the Sea Base. The connector will require some amphibious capability ranging from the ability to cross sandbars, shoals, and mud flats to the ability to deliver its cargo ashore above the high water level. The payload for delivery by the connector to the beach should be at minimum 75 long tons (LT) with an objective of 210 LT. Since the distances are much greater than typical for current well deck connector transits, increased speed in excess of 20 nautical miles per hour (knots) is of great interest. Concepts for, or technologies that would enable, well deck transported connectors to achieve, or approach, this speed, while carrying the full payload, are of interest and higher speeds are desired if possible to reduce the transit/sortie times. The connector should be capable of embarking and launching amphibious vehicles such as the Amphibious Assault Vehicle (AAV-7) in stream (at-sea) so they can swim ashore or to a well deck ship if operations dictate.

The movement of amphibious combat vehicles, tanks, and other equipment, material, and personnel ashore from greater standoff distance from the shore requires surface connectors with a combination of range, speed, and payload that is not available in the fleet today. Current well deck surface connectors include the Landing Craft Air Cushion (LCAC) which is fully-amphibious, can operate at high speeds and carry the threshold payload, but has limited range when carrying a full payload in the higher range of allowable sea states; and the Landing Craft Utility (LCU 1600) cannot cross very shallow waters (over sand bars, shoals, mud flats, etc.) but has greater payload capacity and range, albeit at speeds below the desired capability. Another developmental well deck capable surface connector is the Ultra-Heavylift Amphibious Connector (UHAC), which has been demonstrated at roughly ½ scale. At full-scale, it has the potential to achieve the 20 knot target speed with the objective payload over a distance of about 100 nm. Other landing craft concepts that have been attempted and may provide a source of ideas are the Power Augmented Ram Landing Craft (PARLC) and the Russian Navy's Dyugon-class. Each of these well deck transported surface connectors meets some aspects of the desired capability, but no one connector meets all of the desired capabilities of speed, payload, and range. This topic is seeking technologies that may enable any of these connectors to meet all three objectives as well as entirely new connector concepts that offer breakthrough performance.

PHASE I: Develop a conceptual design for a surface connector that is compatible with amphibious ship well deck constraints, or identify and assess the feasibility for new enabling technology of existing surface connector platforms.

The deliverable for Phase I should clearly describe the concept or technology, address the impact of the concept or enabling technology on mission capability and affordability, and include by analysis, and/or existing test results, support for claims of performance improvements and capabilities. Life cycle cost is critical to the fielding of any concepts/technologies and should be considered.

PHASE II: Through modeling and simulation, physical scale-modeling, or a combination of both, the small business will validate the performance claims made in Phase I for any design concept or technology. As appropriate, the small business will develop an analytical model of the full-scale concept, a sub-scale physical model, or a component-level demonstration of the enabling technology to assess feasibility. Design drawings or a technical data package will be produced to facilitate commercialization.

PHASE III: Existing platforms will be utilized as a test bed to demonstrate the capability for achieving the speed/payload/range objectives and the well deck and amphibious capabilities, at an appropriate scale and level of fidelity.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Access to austere coastlines while carrying large payloads would be attractive to commercial ventures involved in exploration for, or production, of oil, gas, or mineral resources. Another application may be in humanitarian assistance/disaster relief missions into areas where the normal port access may have been degraded or destroyed.

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KEYWORDS: Surface connector; well deck; amphibious; high speed; range; payload; landing craft

TPOC: Frank Leban
Email: Frank.Leban@navy.mil
2nd TPOC: Geoffrey Main
Email: geoffrey.main@navy.mil

N151-076 TITLE: Compact, Polarization Preserving Antennas for the 40-200 GHz Frequency Range

TECHNOLOGY AREAS: Sensors, Electronics, Space Platforms

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Build a high gain, low noise figure, rad-hard, dual polarization, electronically steered, multi-beam antenna array for the 40-200 GHz frequency range using a scalable subarray design.

DESCRIPTION: Capital ships and satellites often use dish antennas to produce antenna patterns with narrow main beams and highly suppressed side lobes. But then, only one direction can be studied at a time. From all but geostationary orbits, this severely limits the time any given spot on the earth can be observed and such orbits severely limit the total field of view. Replacing the dish with an electronically steered array capable of forming, say, 4 beams, would increase the observation time of each spot in the pattern by a factor of 4, allowing less intense signals to be received. A quasi-conformal geometry would allow the mechanical risk to the mission of a failed on-orbit deployment to be eliminated. The use of extreme bandwidths is both enabled and made desirable by the still low utilization of these high frequencies for communications. In the radiometry application, the intended signal is the black body emission from the earth's surface and atomic and molecular thermal emissions. Both polarizations are required for the data to be interpreted properly. The signals normally occur at power levels below -150 dBm, so antenna gain is definitely desirable from both power and beam pattern point of view. Frequency dependent onductor loss must be considered because of the high frequency and the ideal of flat antenna gain. Active thermal control may be desirable to stabilize the operating temperature and thus conductive loss and antenna gain, even if superconducting materials are not used in the fabrication. Because of the short wavelengths at these high frequencies, the individual antennas will be very miniature, especially at the antenna feed and in connecting to the beam forming module. Distributed feed points may also be helpful to consider. Whole wafer lithography fabrication techniques may be required. Proposals should identify the class of antenna element that will be developed, conductor and substrate materials, and fabrication method. Goals should be defined for main beam width, side lobe suppression, noise figure, and antenna power gain, and planned method for forming 4, 16, 64,.... (and so on) simultaneous beams. The Phase I base effort must provide confidence that the minimal 4 beam 5:1 array can be delivered by the end of the proposed Phase II effort.

PHASE I: Determine technical feasibility and document by simulation (using industry standard CAD tools) and preliminary experimentation that the required antenna elements and feed structures can be manufactured to the specifications detailed in the description. The Phase I option, if exercised, should continue development of the required subcomponents, including experimental exploration of which design variation has better yield. Phase II proposal (due at end of Phase I base) should include a discussion of notional packaging concerns for the space and maritime environments.

PHASE II: Phase II shall include several design/fabrication/test cycles leading to an increase in the accuracy with which the performance limiting factors for the arrays are known and how these parameters scale with the number of elements and beams formed. Document the stability of performance parameters achieved under heat load conditions corresponding to the more extreme case of solar illumination and deep space exposure alternation, regardless of whether active temperature control is proposed. Design and demonstrate a suitable radome for the demonstrated antenna.

PHASE III: Finalize development of an optimally scaled array incorporated into the design of a future earth observing satellite having a mission similar to that of WINDSAT or a future capital ship communications system.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Currently there are commercial collision avoidance radar applications in the 60 GHz range, and the 94 GHz range is being developed quickly. Moreover, short range communications, such as WiFi hot spots, can best be accomplished over portions of the spectrum with large atmospheric attenuation which allows each user (due to their 100's of meters physical separation) to utilize wide frequency bands without interfering with other users. This allows high data rate information to be successfully transmitted. While these applications are not as wideband as those requested in this SBIR, it is the technology for forming the feeds and matching networks that must be developed here, and that will directly transition to these commercial applications. By demonstrating wideband capability, narrower sub-bands will have been proven. There is also a commercial SatCom and wireless data transmission community.

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KEYWORDS: wideband antennas; electronically steered arrays; antenna patterns; array gain; earth observation; black body radiation

TPOC: Deborah VanVechten
Email: deborah.vanvechten@navy.mil
2nd TPOC: Michael Lovellette
Email: Michael.Lovellette@nrl.navy.mil

N151-077 TITLE: Developing Psychological Flexibility

TECHNOLOGY AREAS: Biomedical, Human Systems

ACQUISITION PROGRAM: FNC - Accelerating the Development of Small Unit Decision Makers FY15

OBJECTIVE: To develop a psychological flexibility training and education curriculum that furthers the current body of knowledge using non-proprietary materials and information, and integrates within the curriculum physiological sensor and performance metrics to support an understanding and awareness of the impact of psychological stressors on an individual.

DESCRIPTION: There are significant consequences with the psychological stress that warfighters experience during military operations. Psychological stress permeates every aspects of the service member's life, affecting job, health, relationships, quality of life, etc. Between 2007 and 2012, the Department of Defense (DOD) spent roughly $4.5 billion on mental health treatment for active duty service members and activated National Guard and reserve members [1]. A recent Institute of Medicine report summarizes the numerous resilience and prevention programs that were funded during this time. The report concluded that while some of these programs have demonstrated effectiveness at reducing the effects of stress, many are not evidence-based and are evaluated infrequently [2].

One area of increasing study for mitigating the effects of stress involves techniques related to the mind-body connection/awareness. A variety of methods and techniques relating to mind-body awareness have been developed to prevent and reduce stress (Examples: Mindfulness-Based Stress Reduction (MBSR) [3-6], Integrative Body-Mind Training (IBMT) [7-12], and breathing techniques [10, 13-17]). However, it is unclear which factors/skills/components are critical and most effective at cultivating psychological flexibility when compared against a range of other techniques. Moreover, most training exercises require guidance from certified instructors. With dwindling budgets and reductions in manpower, such requirements cannot be supported. Additionally, military personnel face time constraints that limit opportunities to learn and implement the skills associated with psychological flexibility.

Integration within existing activities, such as Physical Training (PT), could prove to be a beneficial cost and time saving solution. For example, a curriculum of practical short-term meditation/mindfulness techniques could be provided before, during, or after a run or other outdoor exercises. Alternatively, a curriculum and sensor technologies (e.g. heart rate) could be leveraged by an individual at a gym, home, or training facility (e.g. Infantry Immersive Trainer) between exercises or activities. Regardless of the specific application, techniques and technologies are needed to develop cost-effective methods that are sensitive to time and workload of military personnel and able to mitigate stress effects on warfighter performance and health. The results of this effort will yield capabilities that will quantifiably reduce negative outcomes associated with stress injuries, while enhancing the performance and health of military personnel.

The capabilities (techniques and technologies) sought must be non-proprietary, open source, safe, evidence-based, and easily utilized. New components or techniques should enable administration and outcome assessment without substantial manpower or technical knowledge. The primary capability sought must build on a psychological flexibility training and education curriculum as well as integrate human performance metrics and sensor technologies that are transferable between classroom, field, and home environment.

PHASE I: Define and develop a concept for techniques and technologies that are able to mitigate stress effects on warfighter performance and health, and whose methods are cost effective and sensitive to time and workload of military personnel. Required Phase I deliverables will include a final report, Phase II plans, and a proposed psychological flexibility curriculum, human performance metrics, and initial prototype or mockup of sensor technologies. The final report will include evidence-based information, system performance information, and plans for Phase II. Phase II plans should include key components, technological milestones, and plans for at least one operational test and evaluation. Phase I should also include the processing and submission of all required human subjects use protocols, should these be required. Due to the long review times involved, human subject research is strongly discouraged during Phase I.

PHASE II: Required Phase II deliverables will include the construction, demonstration, and assessment of the curriculum and prototype, based on results from Phase I. All appropriate engineering and human research testing will be performed. A critical design/research review will be performed to finalize the design and assessment plans. Additional deliverables will include: 1) final curriculum; 2) training manual and exercises materials (e.g., video) associated with the curriculum; 3) a working sensor technologies and human performance data collection prototype; 4) drawings and specification for its construction; and 5) test data on its performance collected in one or more simulated operational settings, in accordance with the demo success criteria developed in Phase I.

PHASE III: If Phase II is successful, the company will be expected to provide support in transitioning the technology for Marine Corps or Navy use within training. The company will support the Marine Corps with certifying and qualifying the system for Marine Corps use. In addition, other commercial sectors (e.g., athletics) or federal agencies (e.g., FBI) may be interested in the use of the technology and could serve as another avenue for transition the technology.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology will have broad applications in military as well as commercial settings where personnel are exposed to events that have a high probability of inducing stress and stress-related disorders. For the military, psychological flexibility may be integrated into: 1) entry-level training, such as Basic School; 2) pre-deployment training curricula, such as the Infantry Immersive Trainer; 3) deployment to combat zones, administered by Combat Operational Stress Control (COSC) units; and 4) as part of re-acclimation programs at the end of a tour. In commercial settings, these solutions may be similarly integrated into existing programs or as part of daily activities. Commercial applications in which these solutions are expected to be particularly effective include: disaster and crisis management, first responders, law enforcement, and humanitarian relief efforts.

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KEYWORDS: Military health system; warrior resilience; stress inoculation; psychological flexibility; mindfulness; mental health

TPOC: Peter Squire
Email: peter.squire@navy.mil
2nd TPOC: Harold Hawkins
Email: harold.hawkins@navy.mil

N151-078 TITLE: Development of a Diver Biometric Device (DBD)

TECHNOLOGY AREAS: Biomedical, Electronics, Human Systems

ACQUISITION PROGRAM: Seal Delivery Vehicle & Shallow Water Combat Submersible Program ACAT III

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: This effort will develop a biometric monitoring system for use with divers in salt water and at depth. The Diver Biometric Device (DBD) will enable both operational and research health assessment and performance enhancement by the measurement of appropriate physiological signals and their associated algorithms.

DESCRIPTION: The Diver Biometric Device (DBD) will be a waterproof/depth-capable device for collecting and processing physiological data. The goal is to provide divers operating in the challenging undersea environment an indication of their health and performance status. The DBD will also provide currently unavailable metrics for undersea medical research. Metrics of interest include: heart rate, respiration (rate, end tidal carbon dioxide), blood gases (oxygenation, nitrogen and carbon dioxide level, bubble formation), blood pressure, temperature (core, skin and ambient), and electrophysiology (cardiac, encephalic). Synchronized information on the dive profile would also be useful (position, depth, time, SCUBA status).

Biomedical issues that must be addressed when diving include drowning, heart failure, barotraumas, hypo/hyperthermia, nitrogen narcosis, oxygen toxicity, decompression sickness, arterial gas embolism, high pressure nervous syndrome, fatigue, stress, sleep deprivation, underwater blasts, and diving in polluted water.

Terrestrial biometric monitoring is currently in use and providing invaluable capabilities. The key challenge here is that the DBD must provide full function and communication while immersed in salt water and exposed to increased hyperbaric pressures of 300 feet of sea water (FSW) (threshold)/1000 FSW (objective) at a temperature range of 32-95 Degrees F.

No integrated DBD capability for operational environments exists. Past Navy efforts have provided an electrocardiogram recording and analysis system for use in a research pool. The Special Operations Command has explored the transmission of biometric data in an underwater environment and has recently received a limited biometric device for safer pool training. The DBD could adapt existing technologies such as terrestrial biometric devices; hydrophobic electrodes for use in water; biometric analysis algorithms; wrist worn dive computers; underwater voice communication devices; gas sensors on the underwater breathing apparatus; diver locator devices; and/or helmet mounted displays for divers.

PHASE I: Define and develop a concept that illustrates the capabilities of the proposed DBD. Development considerations should include Seal Delivery Vehicle (SDV) Pilots, pool swimmers/divers, surface supplied divers and free swimming divers. Phase I will provide key information about the uses and limitations of the system and could include rapid prototyping and/or modeling and simulation.

PHASE II: Develop, demonstrate and validate the DBD prototype system based on the Phase I design concept. The system should be used under the expected extreme environmental conditions (as cited in the Description section) to collect and analyze data and test algorithms against the known diving biomedical issues.

PHASE III: Develop a production ready system for transition to the US Navy's SDV program and potentially to other diving and salvage, training and research programs.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology would be of interest to a variety of non-military divers including the commercial (underwater construction and oil companies) and recreational diving communities. Technical/cave divers and free divers, some of the more dangerous regimes, would greatly benefit. Endurance swimmers and other high level aquatic athletes would benefit from a waterproof DBD system.

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KEYWORDS: biomedical; biometrics; diver; hyperbaric; scuba; health; physiology; human performance; seal; waterproof; undersea; diving; swimming

TPOC: William D'Angelo
Email: William.Dangelo@navy.mil
2nd TPOC: Jay Haran
Email: jay.haran@navy.mil

N151-079 TITLE: Ultra-low Diffusivity High Temperature Capable Insulation

TECHNOLOGY AREAS: Air Platform, Materials/Processes, Weapons

ACQUISITION PROGRAM: Navy Conventional Prompt Global Strike, DARPA Tactical Boost Glide Demo

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Hypersonic flight induces severe heat loads into airframe, control surfaces and internal assemblies. Thermal insulation must be stable at temperatures up to 1000°C, be compact, must resist evaporation and erosion/oxidation, and have low thermal diffusivity to limit heat transfer to support structures and internal electronics.

DESCRIPTION: A thermal protection system (TPS) is used to maintain the aerospace vehicle’s structural temperature within acceptable limits during sustained flight of hypersonic vehicles. Thermal barrier coatings are complex, multi-layered, and multi-material systems with many variants related to composition, processing and microstructure. Reduction in required insulation volumes are needed to fit internal systems into volume-constrained hypersonic vehicles. Reduction in thermal diffusivity below 8 E-8 m2/sec is needed. Ceramic matrix composite (CMC) TPSs have been investigated and are similar to metallic TPSs, but use CMC components which have a higher temperature capability. Metallic and CMC TPSs and blankets can utilize various types of non-load bearing insulations. The use of new materials, innovative textile architectures, and/or high-temperature multilayer insulations (MLI) in either blanket, metallic or CMC TPSs are possible solutions.

Partially Yttria Stabilized Zirconia (YSZ) is the state-of-the-art material used for ceramic TPSs due to its good mechanical and thermal properties. YSZ has thermal diffusivity of 8.8 E-8 m^2/sec. At temperatures higher than 1200°C, YSZ thermal barriers are affected by accelerated sintering and by phase transitions. Exposure above 1200°C results in partial decomposition of metastable zirconia and transformation to monoclinic phase during cooling. This transformation results in volume change and cracking.

PHASE I: Develop proof of concept for diffusivity achievable through combinations of current state-of-the-art insulation materials to achieve the diffusivity not currently achievable with a single material system. Similarly, define approaches for diffusivity reduction achievable through further opacification.

Develop an assessment of the reduction in diffusivity achievable through foams and gels based on high density metals and metal-oxides as well as an assessment of diffusivity reductions achievable in increasing of phonon scattering through addition of dopants. Feasibility of the best approaches will be shown through small-scale material fabrication used in small-scale proof of concept demonstrations.

In the Phase I Option, if awarded, high temperature integration options will be developed allowing attachment of the insulation to metal and Ceramic Matrix Composite materials. These options will provide compliancy sufficient for ambient to 1200°C operation without gaps or tears caused by differences in thermal expansion between the insulation and the parent structure.

PHASE II: Using the best alternative identified in Phase I, produce lots of small-scale insulation bats from which thermal and mechanical properties will be measured. Testing at elevated temperatures will be conducted to determine extent of outgassing and particulate formation. Measure the extent of hydrophilic absorption of moisture. Investigate coating and processing alternatives to reduce water absorption. Develop a plan for accelerated aging testing. Identify fabrication methods for both prototype development of 10 to 50 5lb bats and small scale production of 1000 bats per year. Develop a safety assessment of fabrication methods. Using labor intensive fabrication methods, an initial lot of 10 5lb bats will be fabricated for quality assessment and small sample statistics of performance will be provided. Conduct thermal and mechanical property measurements on the 10 bats. Bat size and shape will be optimized for ease of missile installation. Key cost, size and performance attributes will be developed for commercial application. Designs for commercial application be will be developed and demonstrated.

PHASE III: Using the missile specific design, non-recurring and recurring unit costs will be developed. A lot of 20 bats will be produced of the missile optimized insulation bats. Combined thermal and mechanical property measurements will be conducted on the missile optimized bats. The remaining bats will be provided to the DARPA Tactical Boost Glide demonstration program for evaluation and for incorporation into the Tactical Boost Glide demonstration vehicles. Identify large scale production alternatives. Develop a cost model of expected large scale production to provide estimates of non-recurring and recurring unit production costs. A production concept for commercial application will be developed addressing commercial cost and quality targets.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Improvements to reduce diffusivity of insulation allows reduction of insulation size in space-limited applications such as commercial satellites, rockets for space launch, and long duration capable airplane engines.

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KEYWORDS: Insulation; Diffusivity; Ultra High Temperature Ceramic Composites (UHTC); Metal Foams; Aerogel; Microporous Gel; Ceramic Foams; Foil Multi-Layer Insulation

TPOC: Gil Graff
Email: gil.graff@navy.mil
2nd TPOC: Rick Burnes
Email: richard.burnes@navy.mil

N151-080 TITLE: Counter Intelligence Surveillance and Reconnaissance and Targeting (C-ISRT), Assessment for Electromagnetic Maneuver Warfare (EMW) and Integrated Fires (IF)

TECHNOLOGY AREAS: Information Systems, Battlespace

ACQUISITION PROGRAM: DCGS-N Inc 2 Integrated Fires, PEO C4I PMW-120, ACAT I

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop algorithms and methods to measure the effectiveness of Counter Intelligence Surveillance and Reconnaissance and Targeting (C-ISRT), Cyber and Electronic Warfare effects in near real time in support of Electromagnetic Maneuver Warfare (EMW) and Integrated Fires (IF). The use of game theory or other modeling methods are also needed to quantify the contribution of various C-ISRT and information related capabilities, e.g., Military Deception/Operational Deception (MILDEC/OPDEC), Computer Network Attack (CNA), Computer Network Exploitation (CNE), and active/passive Electronic Attack (EA), to the mission plan and warfighting outcome. The model should enable comparative analysis between various C-ISRT and information related capabilities during mission planning and execution and enable rapid plan modification based on the measured effectiveness.

DESCRIPTION: The U.S. Navy Information Dominance Roadmap 2013-2028 Executive Summary states:

"Integrated Fires will require new capabilities to fully employ integrated information in warfare by expanding the use of advanced electronic warfare and offensive cyber effects to complement existing and planned air, surface and subsurface kinetic weapons within the battlespace. Future information effects will be designed to impact and change adversary behavior, or when necessary, to control, manipulate, deny, degrade or destroy his warfighting capabilities."

Navy IF capabilities are primarily being pursued to: 1) coordinate and synchronize the use of both kinetic and non-kinetic capabilities to achieve desired lethal and non-lethal effects; 2) support all missions and target sets; 3) be applicable in and across all domains (sea, air, land, space and cyberspace); and, 4) be effective across all warfare environments, to include Anti-Access/Area Denial (A2/AD) scenarios.
Future Naval operations will take place in an environment filled with a broad array of friendly, neutral and hostile networked surveillance and targeting systems. The systems will include space-based, air, maritime and land-based sensors that cover the entire electromagnetic spectrum. To be effective in this complex battlespace, the Navy, at all echelons, will be required to leverage technology to minimize possibility of detection and targeting, and create a collaborative EMW environment to coordinate maritime and airborne non-kinetic capabilities, and to be synchronized with traditional fires. To adequately integrate these fires across the entire engagement timeline, metrics are required to make trade-offs between Cyber/EW systems and air and ship weapons systems. The purpose of this research is to develop a methodology to measure and quantify the effectiveness of various C-ISRT, OPDEC/MILDEC, EW and

CNA/CNE effects in near real time based on game theoretical models to quantify the value of C-ISRT and information effects within the context of relevant mission threads to rapidly inform planning and engagement decisions to be made by the warfighter. Proposals should reflect an understanding of the notional Naval Tactical Cloud (NTC) environment. At a high level, that would consist of a utility computing component, a Big Data analytic component (e.g., Hadoop Distributed Files System, Accumulo, MapReduce, and Storm), Semantic Web technologies, and a Data Storage component (e.g., Content Zone). Amazon Web Services and Commercial Cloud Services (C2S) are cloud environments that are equivalent to the NTC. Proposers should ensure that any proposed work under this SBIR is not based on unique or proprietary platforms or systems.

PHASE I: Phase I will result in a design concept for gathering relevant data, including from open sources and ingested sensor data, and demonstrating the feasibility of assessing the effectiveness of various C-ISRT, OPDEC/MILDEC, EW and CNA/CNE effects. The design concept will include a basic model, analytics and metrics to quantify the value of the effects. This work will be at the UNCLASS level.
Required Phase I deliverables will include:
- Design concept
- Block diagram of proposed solution
- Proposed model, analytics, metrics and measurement methodologies identified
- Phase II work plan that describes tasks, schedule and risks
- Phase I Final Report

PHASE II: Based on Phase I efforts and any direction from the program office, Phase II will develop, demonstrate and validate a prototype solution that is hosted in the NTC or equivalent environment. Required Phase II deliverables will include:
- Design architecture, algorithms and data analytics
- Test and validation plan
- Software executables, source code, and software development documentation
- Demonstration of solution effectiveness and relevance in a laboratory environment
- Phase II Final report
This work will be classified at the SECRET//NOFORN level.

PHASE III: Phase III will consist of transitioning the solution to DCGS-N Increment 2, or other appropriate program of record as determined by the program office. Additional development, testing and validation may be required. Source code and software development documentation will be provided in a format compatible with current Navy repositories. This work may be classified at the TS//SCI level. If the selected contractor does not have the required clearances and certification for TS//SCI classified work, the PMW-120 program office will work with the contractor to facilitate clearances of required personnel and facilities. Integration and testing of developed software may need to be performed at a government facility or lab.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The methodologies developed in this SBIR topic may have applicability to gaming and other applications within a cloud architecture. The private sector is quickly moving towards the usage of cloud architectures for numerous commercial applications.

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KEYWORDS: Integrated Fires; Game Theory; Cyber; Electronic Warfare; Cloud Architectures; Modeling

TPOC: Raphael Pei
Phone: (619)221-7694
Email: raphael.pei@navy.mil
2nd TPOC: Jerry Almazan
Phone: (619)524-7889
Email: jerry.almazan@navy.mil